Reed, Angel

From: Schendel, John

Sent: Tuesday, November 17, 2009 2:49 PM

To: Ceron.Leonardo@epamail.epa.gov

Cc: 'jones.katrina@epa.gov'; Mayer, Randy; Reed, Angel; Johnson, Andy; Harrigan, Sandra

Subject: TTEMI-05-003-0078, Vermiculite Exfo Palmetto GAO 148 Site in Woodruff, SC: Submittal of Draft Sampling and Analysis Plan

Attachments: 05-003-0078_Vermiculite GAO 148_SAP_A Draft_111609.pdf

Dear Leonardo,

Attached is a Portable Document Format (PDF) version of the draft sampling and analysis plan (SAP) for the upcoming site investigation. (I apologize for the separate e-mails for each SAP – the folks here require that for document tracking). Please review and submit any comments to my attention. I will address the comments as soon as I receive them and submit a final version. I am preparing a cost estimate for funding the Woodruff, SC project, and I anticipate that I will submit this to you today or tomorrow. Thanks! - John

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QUALITY CONTROL REVIEW SHEET

Job Number:	103DX90170003.0078.0001O	Contract Name:	START III Region 4 Contract

Document Title: Draft Sampling and Analysis Plan,	No of Pages: About	Level Q 1 ☐ Level Q 2 ☑ Level Q 3 ☐ Level Q 4-6 (Special Review) ☐	Preliminary Draft ☐ Draft ☐ Draft Final ☑ Final ☐
Project Name/Client: Vermiculite Exfo Palmetto GAO 148; EPA Region			
Initiated By: Debbie Kristiansen and Jessica	Product Author: Debbie Kristiansen and Jessica	Date Initiated: 11/03/09	Date Due to Client: 11/16/09
		Specialized Reviews:	
QCC: John Schendel	Estimated Hours: 6 / Due Date: 11/16/09	Regulatory Review ☐ Engineering Review ☐	Other: ☐
		(Attach Separate QC Review Sheets to Document These Reviews)	

Technical Reviewer: John Schendel	Est. Hours: 6	Date Due: 11/16/09	Review Date: 11/16/09	Signature: John Schendel (Digitally signed by John Schendel DN: cn=John Schendel, c=US, email=john.schendel@ttemi.com Date: 2009.11.16 16:06:07 -05'00')
Report Item	**No Changes**	**See Text For Changes**	**Please Call to Discuss**	**Comments**
Intended Scope Stated	☐	☐	☐	See comments in track changes.
Technical Adequacy	☐	☐	☐	
Calculations Checked	☐	☐	☐	
Tables/Figures Support Text	☐	☐	☐	
Conclusions Justified	☐	☐	☐	
QCC Confirmation of Changes	☐	☐	☐	

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QCC Notes:

See comments in track changes.

QCC Final Confirmation Signature: John Schendel (Digitally signed by John Schendel DN: cn=John Schendel, c=US, email=john.schendel@ttemi.com Date: 2009.11.16 16:06:35 -05'00') Date: 11/16/09

Rev 1/2008 - JJo

TETRA TECH

November 17, 2009

Mr. Leonardo Ceron
On-Scene Coordinator
U.S. Environmental Protection Agency Region 4
61 Forsyth Street, SW, 11th Floor
Atlanta, Georgia 30303

Subject: **Draft Sampling and Analysis Plan**
Aggressive Air and Activity-Based Air Sampling Event
Vermiculite Exfo Palmetto GAO 148
EPA Contract No. EP-W-05-054 (START III Region 4)
Technical Direction Document (TDD) No. TTEMI-05-003-0078

Dear Mr. Ceron:

The Tetra Tech EM Inc. (Tetra Tech) Superfund Technical Assessment and Response Team (START) submits this draft site-specific sampling and analysis plan for the aggressive air and activity-based air sampling event scheduled for November 30 through December 4, 2009 at the Vermiculite Exfo Palmetto GAO 148 site located in Woodruff, Spartanburg County, South Carolina.

The technical approach presented in this sampling and analysis plan, which includes a site-specific health and safety plan and site-specific quality assurance project plan, has been prepared for your review and approval. Please call John Schendel at (678) 775-3089 if you have any questions regarding this document.

Sincerely,

John Schendel
START III Project Manager

Andrew F. Johnson
START III Program Manager

Enclosure

cc: Katrina Jones, EPA Project Officer
Angel Reed, Tetra Tech START III Document Control Coordinator

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DRAFT
SAMPLING AND ANALYSIS PLAN
AGGRESSIVE AIR AND ACTIVITY-BASED AIR SAMPLING EVENT

VERMICULITE EXFO PALMETTO GAO 148
WOODRUFF, SPARTANBURG COUNTY, SOUTH CAROLINA

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
Region 4
Atlanta, Georgia 30303

Contract No.	:	EP-W-05-054
TDD No.	:	TTEMI-05-003-0078
Date Prepared	:	November 16, 2009
EPA Task Monitor	:	Leonardo Ceron
Telephone No.	:	(404) 562-9129
Prepared by	:	Tetra Tech Inc.
START III Project Manager	:	John Schendel
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Prepared by	Reviewed by	Approved by	Approved by
	John Schendel	Andrew F. Johnson	
Randy Mayer START III Field Team Leader	John Schendel START III Technical Reviewer	Andrew F. Johnson START III Program Manager	Leonardo Ceron EPA On-Scene Coordinator

CONTENTS

1.0 INTRODUCTION

Under Superfund Technical Assessment and Response Team (START) Contract Number (No.) EP-W-05-054, Technical Direction Document No. TTEMI-05-003-0078, the U.S. Environmental Protection Agency (EPA) tasked Tetra Tech EM Inc. (Tetra Tech) to prepare a sampling and analysis plan (SAP) for an aggressive air and activity-based air sampling (ABS) event scheduled for November 30 through December 4, 2009, at the Vermiculite Exfo Palmetto GAO 148 (GAO 148) site in Woodruff, Spartanburg County, South Carolina. The purpose of the SAP is to specify the planned field activities and the type, number, and location of samples to be collected during the sampling event, as well as to describe the sampling methods to be followed. The sampling event will be led and conducted by Tetra Tech under the direction of the EPA Region 4 Emergency Response and Removal Branch.

All activities and procedures discussed and described in this SAP will be conducted in accordance with the approved Tetra Tech Quality Management Plan dated July 2006 (Reference [Ref.] 1). Tetra Tech will carry out site activities in accordance with applicable EPA and other guidance documents to further ensure that all data quality objectives are met. These guidance documents specifically apply to selection of sampling locations, sample types, sampling procedures, general sample analysis, field quality assurance and quality control (QA/QC), and related topics (Refs. 2 through 6, 8, 11).

The primary objective of the aggressive air and activity-based air sampling effort is to evaluate potential human exposures from disturbance of materials potentially contaminated with asbestos through conducting specific activities at the GAO 148 site. Sampling at the site will occur during various disturbance-type activities and will include collection of air samples, bulk material samples (consisting of debris, soil, and vermiculite attic insulation [VAI]), and microvacuum dust samples. The air sampling will include collection of background air samples to establish background levels of asbestos in the air. In addition, weather will be monitored to establish the values of specific meteorological parameters such as wind direction and wind speed. The collected samples will be submitted for analysis for asbestos (bulk material samples will also be analyzed for water [moisture] content and particle size distribution). These sampling and analysis activities will assist in evaluating the presence or absence of asbestos at the site. If asbestos is present, a subsequent objective of the sampling event is to determine whether the asbestos identified is the type that originated from the W.R. Grace vermiculite mine in Libby, Montana. A final objective will be to support an assessment and evaluation of the need for further investigation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

The remainder of this SAP for the aggressive air and activity-based air sampling event at the GAO 148 site is organized as follows:

- Section 2.0 describes the site, its general setting, and background information.
- Section 3.0 summarizes the proposed field activities and sampling, including types of sampling, sampling locations, and sampling methods.
- Section 4.0 discusses data quality objectives.
- Section 5.0 summarizes the fixed laboratory analytical methods.
- Section 6.0 summarizes field work activities and presents the field team and its responsibilities.
- Section 7.0 discusses the disposal of investigation-derived waste (IDW).
- Section 8.0 presents the references cited in this SAP.
- Appendix A presents figures showing the site location and site layout.
- Appendix B provides tables summarizing samples, sampling equipment and specifications, sampling locations, field quality control samples, analytical parameters and methods, required sample containers, preservation methods, and holding times.
- Appendix C provides the site-specific quality assurance project plan (QAPP).
- Appendix D provides the site-specific health and safety plan (HASP).

2.0 SITE BACKGROUND

The site history and background presented below is based on a site visit conducted by EPA and START personnel on October 28, 2009, and through e-mail and telephone communication with the EPA On-Scene Coordinator (OSC).

The GAO 148 site is located at 13101 Highway 221, Woodruff, Spartanburg County, South Carolina, 29388. The geographic coordinates for the site are latitude 34.6977 degrees north and longitude -81.9988 degrees west. The site consists of a large building, which includes: offices; and open air portions housing an exfoliation furnace, several large bays, and a cement mixing plant. Several piles of material are also located on the property. Some portions of the property are paved. The facility currently receives vermiculite concentrate from imported and local sources and expands the concentrate for packaging and shipment offsite. Some portions of the original property have been redeveloped including the construction of additional buildings.

Sampling at the site has been conducted in the past, including on June 6, 2001. Based on information gathered regarding the GAO 148 site, EPA has concluded that further investigation is required at the site.

3.0 PROPOSED SAMPLING PLAN

As stated in Section 1.0, the purpose of the sampling event is to evaluate potential human exposures from disturbance of materials potentially contaminated with asbestos through conducting specific activities at the GAO 148 site. This section describes the proposed activities and associated sampling. Table 1 in Appendix B outlines the types, numbers, and locations of proposed samples and provides details regarding air sampling equipment and specifications (such as flow rates and air sampling durations). Table 2 of Appendix B summarizes the field quality control samples to be collected during field sampling. The analytical parameters and methods and required sample containers, preservation methods, and holding times are presented in Appendix B, Table 3. Analytical methods are additionally discussed in Section 5.0 of this SAP.

3.1 METEOROLOGICAL MONITORING

A portable meteorological station will be located on site during all aggressive air and activity-based activities and associated sampling. Real-time data, including wind speed, wind direction, temperature, and atmospheric pressure, will be available for review on the meteorological station display panel. These meteorological parameters can be measured in various ways, and may be measured during this field effort using the following instrumentation: wind speed and direction may be measured using a combination wind vane and anemometer; temperature may be measured using a thermistor; and atmospheric pressure may be measured using a manifold absolute pressure (MAP) sensor. In particular, the wind direction and wind speed data will be used to establish: (1) staging locations for personnel and the decontamination station, (2) the background sampling locations, (3) the perimeter aggressive air sampling locations, and (4) the activity-based perimeter air sampling locations. This meteorological data will also be stored for later retrieval and use when evaluating the fixed laboratory data.

3.2 BACKGROUND SAMPLING

A background air sample will be collected concurrent with all site activities on each day of the sampling event. A high flow rate air pump (such as a Gillian AirCon 2 air pump) operated at a flow rate of 10 liters per minute (L/min), with an attached 25-millimeter (mm) diameter, 0.8 micrometer (μm) mixed cellulose ester membrane (MCE) filter cassette, will be mounted on a 4 to 5-foot-tall cassette tripod stand. The inlet cap of the filter cassette will be removed (such that it is open-faced) during sampling; the cassette will be positioned downward and perpendicular to the wind direction. The flow rate of the air sampling train created from this assembly will be measured before and after sample collection using a rotameter or Bios DryCal DC-Lite primary flow meter. During flow rate measurement before and after sample collection, it is important to use the filter cassette for collecting the actual sample; this is especially important for the after-sample-collection flow rate measurement because loading of dust and other material during sampling may have altered the flow rate.

Background air samples will be collected offsite (if practical) or at the site perimeter and upwind at a distance sufficient to prevent real-time influence by the aggressive air and activity-based activities conducted at the site. To the degree possible, the location selected for the background air samples will be free of known asbestos contamination. The background air asbestos level should reflect the concentration of asbestos in air for the environmental setting in the vicinity of the site and will be used to help evaluate whether a release from the site has occurred during the field effort. The background air asbestos level does not necessarily represent historical, pre-release conditions or conditions in the absence of influence from potential sources at the site. A background air asbestos level may or may not be less than the analytical detection limit, and if it is greater than the detection limit (and therefore detectable), it will account for variability in local asbestos air concentrations (Ref. 4).

3.3 AGGRESSIVE AIR SAMPLING

Aggressive air sampling may be conducted inside each selected building structure by artificially disturbing the air inside the structure so that asbestos fibers that may be present as settled material are re-entrained in the air. The inside air will be disturbed using leaf blowers and fans. This will simulate worst-case conditions for potential human exposure to asbestos fibers in the air. There may be one or more aggressive air sampling rounds.

For each aggressive air sampling round, several sampling locations will be selected within the structure and at each location there will be two sampling pump assemblies, one set at a low flow rate of 3 L/min and the other set at a high flow rate of 10 L/min. The low flow rate sampling train will consist of a portable air sampling pump (such as an SKC Universal PCXR8 pump), with an attached 25-mm diameter, 0.8 µm MCE filter cassette. The high flow rate sampling train will consist of a portable air sampling pump (such as a Gillian AirCon 2 air pump), with an attached 25-mm diameter, 0.8 µm MCE filter cassette (see Table 1 in Appendix B). The inlet caps of both the low and high flow rate filter cassettes will be removed (such that they are open-faced) during sampling; the cassettes will be positioned downward. The low and high flow rate filter cassettes set up at each sampling location will be mounted as close to each other as possible on a 4 to 5-foot-tall cassette tripod stand.

Air samples will also be collected around the perimeter of the building at upwind and downwind locations to assess the impact of indoor activities on outdoor air (see Table 1 in Appendix B); several air pumps (such as Gillian AirCon 2 air pumps) operated at flow rates of 10 L/min, with an attached 25-mm diameter, 0.8 µm MCE filter cassette, will be mounted on 4 to 5-foot-tall cassette tripod stands. The inlet caps of the filter cassettes will be removed (such that they are open-faced) during sampling; the cassettes will be positioned downward and perpendicular to the wind direction. Perimeter samples will be collected for the duration of each aggressive air sampling activity. Low flow rate sampling pump assemblies will not be collocated with these high flow rate assemblies because heavy loading of these filter cassettes is not anticipated.

The flow rate of the air sampling trains created from these indoor and outdoor (perimeter) assemblies will be measured before and after sample collection using a rotameter or Bios DryCal DC-Lite primary flow meter. As indicated in Section 3.2, it is important to use the filter cassette for collecting the actual sample during flow rate measurement before and after sample collection.

Each aggressive air sampling event will occur over a minimum 400-minute air sampling period. Indoor aggressive air sampling will be conducted by following these steps:

1. Don the appropriate personal protective equipment (PPE), as outlined in the site-specific HASP (see Appendix D).
2. Set up the appropriate number of low and high flow rate sampling assemblies (see Table 1 in Appendix B) throughout the indoor space and attach the air intake hoses to the filter cassettes. Place pumps away from any obstructions that may influence air flow. Do not turn on the pumps or remove the cassette inlet plugs/caps at this time.

3. Place the appropriate number of 20-inch-diameter fans in the center of the room (or otherwise arrayed in a way to promote air circulation), point them toward the ceiling, and set them on low (or other designated) speed.

4. Turn on the leaf blowers and direct their blasts, while walking, against the walls, ceilings, floors, ledges, and other surfaces in the room to initially dislodge fibers from surfaces. This activity step should take at least 5 minutes per 1,000 square feet of floor surface.

5. After the leaf blowers are turned off, allow some time to pass to allow the heavier particles in the air to settle.

6. Remove the cassette plugs/caps and position the cassettes downward, perpendicular to the air movement.

7. Turn on the sampling pumps.

8. Check the pumps midway through the sampling interval (after about 3 to 4 hours have elapsed). If a cassette filter appears darkened or if loose dust is seen in the filter cassette, it should be removed and a second filter cassette should be inserted in the sample train. Both filter cassettes will have the same sample designation and will be submitted to the laboratory for analysis.

9. After a sampling interval of at least 400-minutes, orient each cassette with the inlet facing upward and turn off the pump.

10. Detach each cassette from the pump and replace the plugs/caps on both the inlet and the outlet of the cassette.

11. Wipe the exterior of each cassette clean with a wet towel.

12. Place each cassette, inlet face up, in a paper envelope for shipment to the laboratory.

13. Once the air inside the building has settled, collect bulk material samples as either grab or multi-point composite samples. These samples may consist of heavy dust and debris or vermiculite attic insulation (VAI). If there is not enough dust and debris for collecting bulk material or VAI samples, grab or composite microvacuum dust samples may be collected instead (see Section 3.5 for the sampling procedure). Refer to Appendix B, Table 1 for additional guidance regarding collecting these bulk material and microvacuum dust samples.

Table 1 in Appendix B outlines the proposed sampling locations, equipment, and other specifications for the air, bulk material, and microvacuum dust samples to be collected during each aggressive air sampling event. Table 2 in Appendix B lists the associated field quality control samples.

3.4 ACTIVITY-BASED AIR SAMPLING

ABS will be conducted to simulate human exposure to asbestos during typical site activities. There will be several activity-based outdoor air sampling rounds. ERT guidance indicates that each activity-based air sampling round should be repeated a minimum of three times in an area to expose trends and introduce variability in the way the activity is conducted. This can be accomplished by a single participant repeating an activity three or more times, or by conducting a single activity with three or more participants. The specific activity chosen for each round will be determined in the field (see further discussion below). Each ABS event will occur over a minimum 120-minute period.

During each activity, air samples will be collected from the breathing zones of event participants. The breathing zone can be visualized as a hemisphere approximately 6 to 9 inches around an individual's face. Breathing zone samples provide the best approximation of the concentration of contaminants in the air that an individual may actually breathe (Ref. 4).

Each event participant, wearing the appropriate PPE (see Appendix D), will be fitted with two sampling pumps, one set at a low flow rate of 3 L/min and the other set at a high flow rate of 10 L/min. The pumps will be contained within a backpack or harness, with the filter cassettes secured to the participant's shoulder straps so that their inlets are within the participant's breathing zone. The low flow rate sampling train will consist of a portable air sampling pump (such as an SKC Universal PCXR8 pump), with an attached 25-mm diameter, 0.8 µm MCE filter cassette. The high flow rate sampling train will consist of a portable air sampling pump (such as an SKC QuickTake 30 pump), with an attached 25-mm diameter, 0.8 µm MCE filter cassette. The inlet caps of both the low and high flow rate filter cassettes will be removed (such that they are open-faced) during sampling; the cassettes will be positioned downward.

When two or more participants are involved in an activity-based outdoor air sampling round, each of the relieving participants will don appropriate PPE and will be ready to relieve the preceding participant from the activity before a personnel exchange is made. The original participant will stop the activity, remove the backpack or harness containing the sampling trains, and pass it to the relief participant. The original participant should assist the relief participant with donning and adjusting the backpack (or harness) and the filter cassettes to be within the new participant's breathing zone. The exchange should take less than 60 seconds; therefore, it will not be necessary to halt either the sampling pumps or the event clock. If, however, the exchange requires more than 60 seconds, the pumps and event clock should be stopped until the activity resumes (Ref. 4).

In addition, air samples will also be collected around the perimeter of each activity at upwind and downwind locations to assess the impact of the activity on outdoor air (see Table 1 in Appendix B). Several sampling locations will be selected around the activity area and at each location there will be two sampling pump assemblies, one set at a low flow rate of 3 L/min and the other set at a high flow rate of 10 L/min. The low flow rate sampling train will consist of a portable air sampling pump (such as an SKC Universal PCXR8 pump), with an attached 25-mm diameter, 0.8 μm MCE filter cassette. The high flow rate sampling train will consist of a portable air sampling pump (such as a Gillian AirCon 2 air pump), with an attached 25-mm diameter, 0.8 μm MCE filter cassette (see Table 1 in Appendix B). The inlet caps of both the low and high flow rate filter cassettes will be removed (such that they are open-faced) during sampling; the cassettes will be positioned downward and perpendicular to the wind direction. The low and high flow rate filter cassettes set up at each sampling location will be mounted as close to each other as possible on a 4 to 5-foot-tall cassette tripod stand. Perimeter samples will be collected for the duration of each ABS event.

The flow rate of the air sampling trains created from these participant-worn and perimeter air sampling assemblies will be measured before and after sample collection using a rotameter or Bios DryCal DC-Lite primary flow meter. As indicated in Section 3.2, it is important to use the filter cassette for collecting the actual sample during flow rate measurement before and after sample collection.

Once each ABS event and its associated air sampling are completed, bulk material samples (consisting of debris, soil, and [if present] pure or almost pure VAI) will be collected as either grab or multi-point composite samples from within the area where the activity occurred. These samples may be collected from the piles of debris generated during the activity. If piles are not generated, bulk material samples can be collected from the designated area by digging at the ground surface. If there is not enough debris for collecting bulk material samples, grab or composite microvacuum dust samples may be collected instead (see Section 3.5 for the sampling procedure). Refer to Appendix B, Table 1 for additional guidance regarding collecting these bulk material and microvacuum dust samples.

ABS event and air sampling locations will be selected in the field. This work and associated sampling will be conducted in accordance with EPA ERT SOP No. 2084 (Ref. 4). Table 1 in Appendix B outlines the proposed sampling locations, equipment, and other specifications for the air, bulk material, and microvacuum dust samples to be collected during each ABS event. Table 2 in Appendix B lists the associated field quality control samples.

The following subsections discuss specific activities that may be used during one or more rounds of ABS.

3.4.1 Sweeping

Sweeping is appropriate for sites with hard surfaces such as asphalt, pavement, or concrete that are potentially contaminated with asbestos. Sweeping for this event will occur on an area selected in the field that is paved or otherwise covered with a hard surface such as concrete. Each sweeping event participant will sweep the entire designated area to remove dust and debris using an 18- to 30-inch push broom. A grab or multi-point composite bulk material sample of the swept dust and debris will be collected after the round of sweeping activity is completed; if there is not enough swept dust and debris to collect a bulk material sample, then a grab or composite microvacuum dust sample will be collected from the swept surface using microvacuuming techniques.

The sweeping will be conducted by following these steps:

1. Each sweeping participant will don the appropriate PPE (see Appendix D) and the personal sampling pumps contained in a backpack or harness. The open-faced inlets to the filter cassettes attached to the participant will be oriented within the participant's breathing zone and the pumps will be turned on.

2. The participant will sweep the dust and debris away from him, moving along the length of the designated area, and leave the accumulated debris in a small pile.

3. Turning toward the opposite direction and shifting to start at an adjacent swath of the surface to be swept, the participant will begin sweeping dust and debris across the paved area in the opposite direction.

4. The participant will continue sweeping in this snaking "S" pattern until the entire designated area is swept.

5. The participant will then reverse his sweeping actions, thereby re-distributing the dust and debris throughout the designated area.

6. The participant will repeat the sequence of sweeping and re-spreading the dust and debris for the duration of the sampling period (120 minutes).

3.4.2 Other Potential Activities

Several other disturbance-type activities will be considered for application during one or more of the planned ABS events. These activities include: raking, all terrain vehicle (ATV) riding, bicycling, jogging, and running. The raking activity may be applied at one or more of the unpaved and uncovered areas at the GAO 148 site. The activities will be chosen in the field, and will be conducted according to the EPA ERT SOP No. 2084 (Ref. 4; also provided as Attachment 1). Specifically, ERT SOP No. 2084 provides details on conducting the raking activity in Section 7.5, the ATV riding activity in Section 7.6.1, the bicycling activity in Section 7.6.9, and the jogging and running activity in Section 7.6.8 (Ref. 4 and Attachment 1).

3.5 MICROVACUUM DUST SAMPLING

Microvacuum dust samples may be collected during the aggressive air and activity-based air sampling events if there is not enough dust and debris for collecting bulk material and VAI samples. In conjunction with aggressive air sampling activities, microvacuum dust samples may be collected inside the building structure after the air samples have been collected and the air inside the building has settled. Microvacuum dust samples may also be collected in conjunction with activity-based air sampling activities, after an activity and its associated air sampling has been completed. Dust samples will be collected using microvacuum (microvac) sampling techniques from areas where activities are conducted on solid surfaces (such as rooftops, shelves, blacktop, asphalt, or concrete flooring). The microvac device will consist of a portable air sampling pump (such as an SKC Universal PCXR8 pump) operated at a flow rate of 2 L/min, with an attached 25-mm diameter, 0.45 μm MCE filter cassette. A new, never-before-used length of 6.35-mm inner diameter (0.25-inch-inner diameter) plastic tubing (such as Tygon tubing or equivalent) will be used to create a "nozzle" on the inlet of the cassette for sampling. The sampling end of the nozzle tubing will be cut at an approximate 45-degree angle. The total length of the nozzle tubing should be between 25 and 37 mm (1 to 1.5 inches).

The flow rate of the air sampling train created from the microvacuum dust sampling assembly will be measured before and after sample collection using a rotameter or Bios DryCal DC-Lite primary flow meter. As indicated in Section 3.2, it is important to use the filter cassette for collecting the actual sample during flow rate measurement before and after sample collection. The flow rate used for sampling (about 2 L/min) will provide an approximate air velocity of 100 centimeters per second (cm/sec) through the 6.35-mm inner diameter (0.25-inch-inner diameter) plastic nozzle tubing.

If microvacuum dust samples are collected, each sample will consist of a grab or multi-point (multi-aliquot) composite dust sample. The number of aliquots used for collecting composite dust samples will be determined in the field. The sampling area for each grab sample or for each of the composite sample aliquots should be at least 100 square centimeters (cm^2). If surfaces that are not very dusty are encountered, it may be determined that larger surface areas should be vacuumed. In addition, some surfaces of interest may have a smaller surface area than 100 cm^2, and exceptions to the minimum sampling area will be made in such cases. Appendix B, Table 1 provides more details regarding the numbers and locations proposed for microvacuum dust samples that may be collected during the aggressive air and activity-based air sampling events.

Microvacuum dust will be sampled using the following these steps:

1. Collect each grab sample or composite sample aliquot by turning the pump on and passing the angle-cut nozzle across the 100-cm^2 (or greater) delineated surface for a minimum of two passes (oriented at right-angles to each other), the total duration lasting for a minimum 120-second interval. Avoid scraping or abrading the surface being sampled. Do not sample any debris greater than 1 mm in diameter.

2. After approximately 120 seconds (or greater) at the grab sample or composite sample aliquot sampling point, invert the cassette so that the nozzle faces up, stop the sampling pump, and go to Step 4 (for grab samples), or move to the next point (for composite samples).

3. Repeat Steps 1 and 2 above until all composite sample aliquot points have been collected using the same pump, filter cassette, and nozzle assembly. Use a stopwatch to measure each sample aliquot sampling interval and the total composite sample collection time. Record the sample collection time data.

4. When the grab sample or all composite sample aliquots have been collected, invert the cassette so that the nozzle faces up and any loose dust falls into the cassette. Turn off the pump.

5. Keep the cassette and nozzle oriented so that the nozzle faces up. Detach each cassette from the tubing connecting it to the pump. Seal the cassette outlet with its end plug.

6. Seal the inlet to the nozzle with a plug and tape the base (outlet end) of the nozzle securely to the cassette to prevent separation of the nozzle and cassette assembly during handling. Alternately, remove the nozzle from the cassette, plug the inlet of the cassette with its end plug, seal both ends of the nozzle with other plugs, and place the nozzle in a separate closeable plastic bag.

7. Wipe the exterior of each cassette and nozzle tubing clean with a damp towel.

8. Place each cassette and attached nozzle assembly in a paper envelope for shipment to the laboratory. If the cassette and nozzle are separated, place each in a separate envelope. The nozzle will be included in the shipment to the laboratory because significant quantities of dust can adhere to the inside walls of the nozzle.

Table 1 in Appendix B outlines the potential sampling locations, equipment, and other specifications for the microvacuum dust samples to be collected during each aggressive air and activity-based air sampling event. Table 2 in Appendix B lists the associated field quality control samples. Microvacuum dust sampling will be conducted in accordance with American Society for Testing and Materials (ASTM) Method D5755-95 (Ref. 6).

3.6 ADDITIONAL BULK SAMPLING

In addition to the bulk material and VAI samples that are proposed in association with each of the rounds of aggressive air and activity-based air sampling planned for this field event, additional bulk material samples may also be collected. Sampling locations for any additional samples will be determined in the field through reconnaissance and observation. Bulk material and VAI samples will be collected as either a grab or multi-point composite samples by digging at the ground surface using either a spoon or a hand auger, or by withdrawing material from piles, hoppers, and other containers. Refer to Appendix B, Table 1 for further details regarding collecting these additional samples.

4.0 DATA QUALITY OBJECTIVES

Sampling and fixed laboratory analysis will be conducted to determine: (1) the presence or absence of asbestos fibers in the collected samples, (2) the concentrations of asbestos fibers in air in the study areas during the aggressive air and activity-based air sampling activities, (3) whether human exposure to asbestos through inhalation may potentially occur during typical activities at the site, (4) whether potential background sources of asbestos are contributing to air quality in the vicinity of the site, and (5) whether on-site asbestos originated from the vermiculite mine in Libby, Montana. Ultimately, the data will be used to assess whether or not further action is required at the site; the assessment approach is beyond the scope of this SAP.

The sampling approach, including determining the type and number of asbestos samples collected, will be biased to identify source locations. Field quality control samples will be collected during the sampling event to monitor sampling precision and assess the cleanliness of the air sampling media and other sampling equipment. Table 2 of Appendix B summarizes the sample designations, types, and sampling rationales for all proposed field quality control samples.

The sensitivity requirements for the fixed laboratory analytical methods are as follows:

- The analytical range for the California Environmental Protection Agency, Air Resources Board (CARB) Method 435 (Ref. 8) is 0.25 percent to 100 percent asbestos. The detection limit is 0.25 percent asbestos. Because this method will be modified for use for this project (see Ref. 7 for further details), these range and detection limit values may not apply to the analysis of the samples.

- For the analysis of pure or almost pure VAI by EPA Method EPA/600/R-04/004 (Ref. 11), the analytical range, for the portion of the method wherein the fraction of sample that "sinks" is analyzed (the rapid screening procedure), is estimated to be about 0.01 percent to 100 percent by weight of fibrous amphibole; the detection limit for the analysis of this fraction is estimated to be less than about 0.01 percent by weight of fibrous amphibole. If the portion of the method for the analysis of the "suspended particle fraction" is used, the analytical range and limit of detection can vary.

- For analysis of microvacuum dust samples by the American Society for Testing and Materials (ASTM) Method D5755-95 (Ref. 6), the method is expected to be generally capable of measuring the surface loading of asbestos structures starting at about 1,000 asbestos structures per square centimeter (cm^2).

- For analysis of the air samples by International Organization for Standardization (ISO) Method ISO 10312: 1995 (Ref. 12), the required sensitivity limit for asbestos is either 0.001 structures per cubic centimeter (s/cm^3) or 0.0001 s/cm^3, depending on the collected air volumes, the number of grid openings counted, and other variables. The required detection limit for asbestos is either 0.003 s/cm^3 or 0.0003 s/cm^3, again depending on the same considerations (see Ref. 7 for further details).

Initial acceptance of the fixed laboratory analytical data will be determined through data validation conducted by the Quality Assurance Technical Support contractor, Shaw Environmental and Infrastructure. A data validation report will be prepared that will indicate any rejected data and the reasons for their rejection, and will present the limitations to the data based upon the review of the data quality. It will be the responsibility of the EPA OSC to determine the impact any data qualifications and limitations have on data usability. Additional information regarding the project data quality objectives is provided in the site-specific QAPP presented in Appendix C.

Chain-of-custody of the samples collected during the field event will follow requirements provided in the site-specific QAPP (Appendix C) and, by reference, the appropriate operating procedures in the EPA Region 4 Science and Ecosystem Support Division (SESD) document *Field Branches Quality System and Technical Procedures* (Ref. 2).

5.0 ANALYTICAL METHODS

All samples will be submitted for analysis to a laboratory competitively procured by EPA Region 4. The procurement process included specifying to the bidding laboratories the analytical methods to be used to analyze the collected samples, and other analytical specifications (Ref. 7). The laboratory chosen through the initial procurement is International Asbestos Testing Laboratory, Inc, (IATL) located in Mt. Laurel, New Jersey. Accreditation of the laboratory for the analysis of the air samples is primarily provided by the National Institute of Standards and Technology (NIST) through the National Voluntary Laboratory Accreditation Program (NVLAP). Due to funding limits placed on the initial contract with IATL by EPA Region 4, some of the fixed laboratory analytical work conducted for this project will be through a follow-on competitive procurement process, meaning that a laboratory other than IATL may be analyzing some of the samples collected at the GAO 148 site.

The analytical parameters and methods are presented in *Request for Analytical Services,* EPA Region 4 Superfund Division, June 18, 2009 (Ref. 7). Any variations in the analytical methods will be specified in and communicated through the EPA laboratory assignment and subsequently in the final report (other method variations and changes to analytical requirements may be provided in a new request for analytical services forthcoming in the follow-on competitive procurement mentioned in the previous paragraph). Table 3 of Appendix B specifies the analytical methods for each sample matrix, the required sample containers, preservation methods, and sample holding times (Refs. 6; 8 through 13). The site-specific QAPP is provided in Appendix C. The EPA Region 4-procured analytical data packages will be validated by the Quality Assurance Technical Support contractor, Shaw Environmental and Infrastructure.

6.0 FIELD WORK SUMMARY

Tetra Tech and EPA will conduct aggressive air and activity-based air sampling activities at the GAO 148 site during the period of November 30 through December 4, 2009. Tetra Tech will process all samples using the EPA Scribe software, which will generate a site data base. The Scribe data base will be stored at the Tetra Tech, Duluth, Georgia office while data entry is being conducted. Once completed, the data base will be submitted to EPA. Proposed sampling activities are described in Section 3.0 of this SAP. The Tetra Tech field team leader or the EPA OSC may change sampling locations and the number of samples to be collected in response to site conditions at the time of the field event. Sampling will be conducted, and field quality control samples will be collected, in accordance with the guidance documents presented in Section 1.0 (Refs. 2 through 6, 8, 11). Tetra Tech will follow the health and safety protocol during the sampling event as outlined in the site-specific HASP presented in Appendix D.

Anticipated field team members and their responsibilities are as follows:

- Leonardo Ceron, EPA — On-Scene Coordinator
- John Schendel, Tetra Tech — Project Manager

• Randy Mayer, Tetra Tech	Field Team Leader
• Debbie Kristiansen, Tetra Tech	Field Team Member
• Spencer Smith, Tetra Tech	Field Team Member
• James Ferreira, Tetra Tech	Field Team Member
• Vicky Farmer, Tetra Tech	Field Team Member

All specific training requirements for personnel will be addressed in the site-specific HASP. EPA will be responsible for obtaining access to the GAO 148 site property and any offsite background sampling locations. EPA reserves the right to conduct oversight of sampling.

7.0 DISPOSAL OF INVESTIGATION-DERIVED WASTE

IDW will generally consist of disposable latex or nitrile gloves, boot covers, Tyvek protective suits, duct tape, plastic bags, spent breathing air cartridges, and paper towels. These items are used mainly for sample collection, to prevent cross-contamination during sampling activities, and to provide protection and sanitary conditions to personnel throughout field work. IDW may also include rinse water generated during decontamination activities; this water is expected to be minimal in volume because every effort will be made to allow the water to evaporate while field activities occur. Because of the potential for exposure to asbestos, materials such as broom heads will also be disposed and not reused on other projects. IDW will be secured on site in sealed plastic bags or in a plastic-bag-lined 55-gallon drum. Once field work is complete, the fans and leaf blowers used during the aggressive air sampling events will be sealed in plastic and left on site until the air, dust, and bulk material sample analytical results are received. If asbestos is not present in these samples, the fans and leaf blowers may be retrieved and reused on subsequent sites; otherwise they will be properly disposed. If air, dust, and bulk material sample analytical results indicate that asbestos existed at the site, the IDW may require analysis and disposal according to applicable regulations. If IDW analytical results reveal contamination at levels that require special handling, these wastes will be disposed by a licensed transport and disposal firm. Up to 3 months will be allowed to complete the IDW profile and procurement of a transport and disposal firm.

If, in the best professional judgment of the Tetra Tech field team leader and the EPA OSC, the IDW can be rendered nonhazardous, the IDW will be double-bagged and deposited in an industrial waste container (Ref. 14).

8.0 REFERENCES

1. Tetra Tech EM Inc. (Tetra Tech). 2006. *Quality Management Plan.* EPA Region 4, Superfund Technical Assessment and Response Team (START) III. July.

2. U.S. Environmental Protection Agency (EPA). 2007 through 2009. Region 4 Science and Ecosystem Support Division (SESD). *Field Branches Quality System and Technical Procedures: Control of Records (SESDPROC-002-R4)*, February 2008; *Sample and Evidence Management (SESDPROC-005-R1),* November 2007; *Logbooks (SESDPROC-010-R3)*, November 2007; *Global Positioning System (SESDPROC-110-R2)*, November 2007; *Ambient Air Sampling (SESDPROC-303-R1),* November 2007; *Soil Sampling (SESDPROC-300-R1)*, November 2007; *Waste Sampling (SESDPROC-302-R1)*, November 2007; *Bulk Sampling for Asbestos (SESDGUID-104-R0)*, August 2009; *Field Sampling Quality Control (SESDPROC-011-R2)*, January 2008; *Packing, Marking, Labeling and Shipping of Environmental and Waste Samples (SESDPROC-209-R1)*, November 2007; *Management of Investigation Derived Waste (SESDPROC-202-R1)*, November 2007; *Field Equipment Cleaning and Decontamination (SESDPROC-205-R1)*, November 2007; and *Equipment Inventory and Management (SESDPROC-108-R3)*, April 2009. On-Line Address: http://www.epa.gov/region4/sesd/fbqstp/index.html.

3. EPA. 2008. Asbestos Committee of the Technical Review Workgroup of the Office of Solid Waste and Emergency Response (OSWER). *Framework for Investigating Asbestos-Contaminated Superfund Sites*. OSWER Directive #9200.0-68. September.

4. EPA. 2007. Environmental Response Team (ERT). *Activity-Based Air Sampling for Asbestos.* Standard Operating Procedure (SOP) No. 2084, Rev. No. 0.0. May 10.

5. EPA. 1994. ERT. *Asbestos Sampling*. SOP No. 2015, Rev. No. 0.0. November 17.

6. American Society for Testing and Materials (ASTM). 1995. *D5755-95 Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Concentrations.* (Note: This method is the one cited in the EPA request for analytical services [see Ref. 7 below]. It is, however, a historical standard that has been superseded. The most recent version is: ASTM International. 2003. *D5755-03 Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Surface Loading.* April 10.)

7. EPA. 2009. Region 4 Superfund Division. Nardina Turner, Technical Representative. *Request for Analytical Services*. June 18.

8. California Environmental Protection Agency, Air Resources Board (CARB). 1991. *Method 435, Determination of Asbestos Content of Serpentine Aggregate*. Adopted June 6.

9. ASTM. 2000. *D4643-00 Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method.* March. (Note: This method is the one cited in the EPA request for analytical services [see Ref. 7 above]. It is, however, an older version of the standard test method. The most recent version is designated D4643-08.)

10. ASTM International. 2007. *D422-63 (2007) Standard Test Method for Particle-Size Analysis of Soils*. October.

11. EPA. 2004. Office of Research and Development. *Research Method for Sampling and Analysis of Fibrous Amphibole in Vermiculite Attic Insulation*. EPA/600/R-04/004. January. This method can be found at the following web address: http://www.epa.gov/nrmrl/pubs/600r04004/600r04004.pdf.

12. International Organization for Standardization (ISO). 1995. *ISO 10312: 1995 - Ambient Air – Determination of Asbestos Fibers - Direct Transfer Transmission Electron Microscopy Method.*

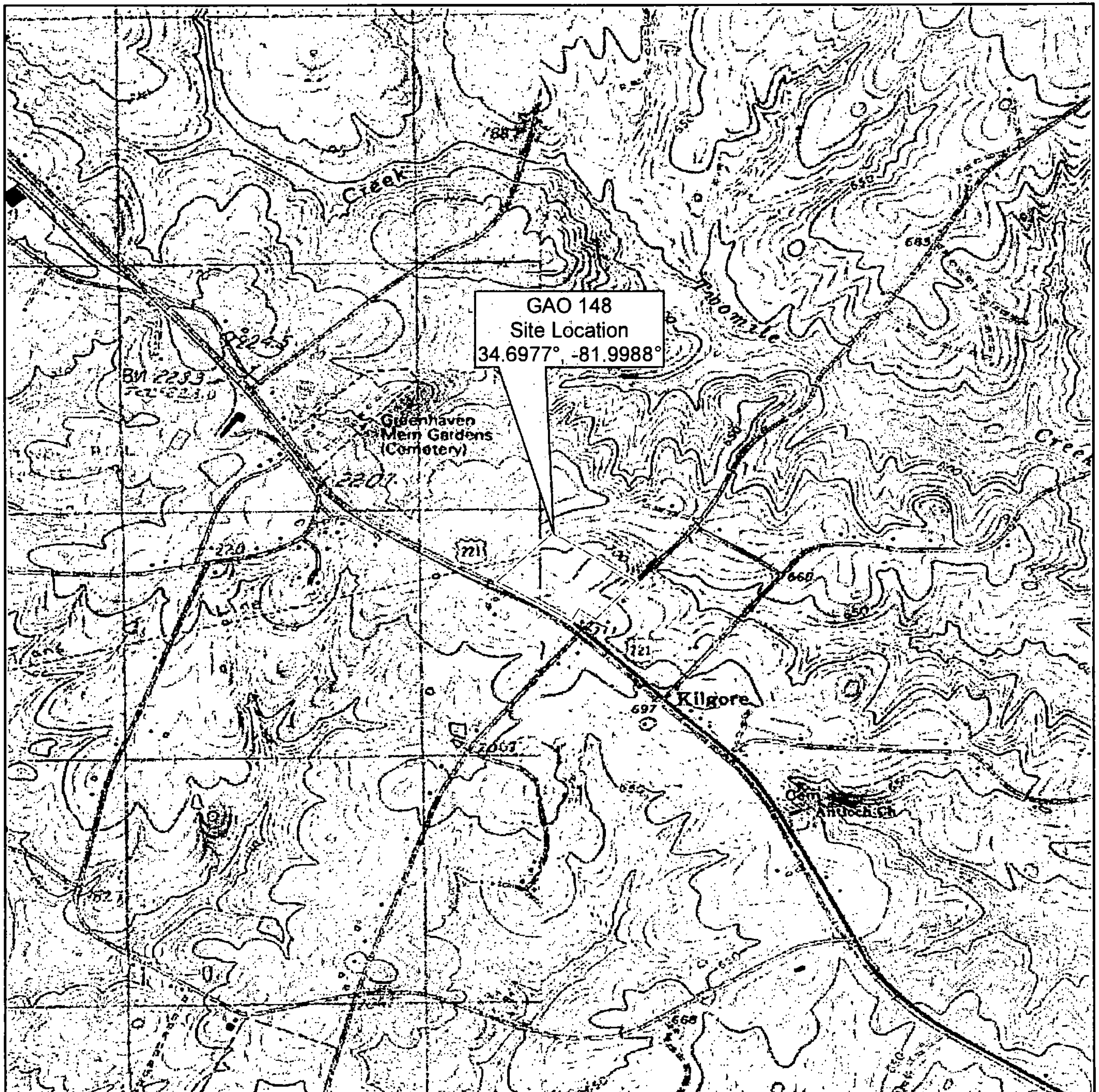
13. ISO. 1999. *ISO 13794: 1999 - Ambient Air – Determination of Asbestos Fibers – Indirect-Transfer Transmission Electron Microscopy Method.*

14. EPA. 1991. OSWER. *Management of Investigation-Derived* Waste *During Site Inspections*. EPA Document No. EPA 540-G-91-009. OSWER Directive No. 9345.3-02. May 1.

APPENDIX A

FIGURES

(Two Pages)

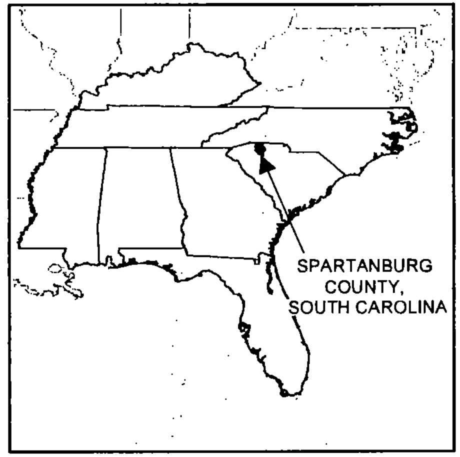


Legend

Approximate Property Boundary

0 1,000 2,000 Feet

MAP SOURCE:
USGS, ENOREE & WOODRUFF
TOPOGRAPHIC QUADRANGLES, 1983



United States Environmental Protection Agency

VERMICULITE PALMETTO
EXFO GAO 148
WOODRUFF,
SPARTANBURG COUNTY,
SOUTH CAROLINA
TDD No.TTEMI-05-003-0078

FIGURE 1
SITE LOCATION

TETRA TECH

Legend

Approximate Property Boundary

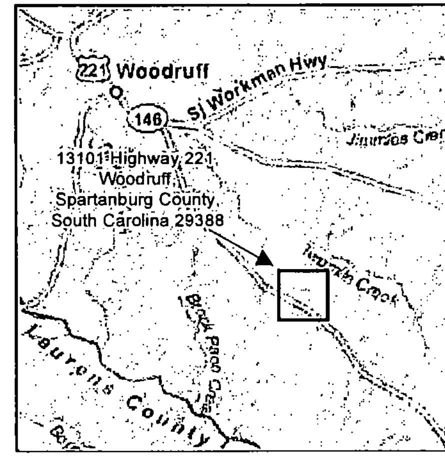
Street Boundary

Railroad

0 250 500 Feet

N S E W

MAP SOURCE:
ImageConnect 'Digital Globe'
GlobeXplorer 04-17-2009



United States Environmental Protection Agency

VERMICULITE PALMETTO
EXFO GAO 148
WOODRUFF,
SPARTANBURG COUNTY,
SOUTH CAROLINA
TDD No.TTEMI-05-003-0078

FIGURE 2
SITE LAYOUT

TETRA TECH

C:\GIS_Workspace\TTEMI-05-003-0078_Woodruff_SC_Vermiculite_Site_GAO_148\GIS\MXDs\WOODRUFF SC VERMICULITE SITE LAYOUT MAP 11-09-09.mxd TTEMI-D4 courtney.roden 2009-11-09

APPENDIX B

TABLES

(Ten Pages)

TABLE

TABLE 1
AGGRESSIVE AIR AND ACTIVITY-BASED AIR SAMPLING EVENTS
SAMPLES, SAMPLING EQUIPMENT AND SPECIFICATIONS, AND SAMPLING LOCATIONS

Station ID	Sample Designation	Pump Flow Rate (L/min)	Sampling Duration (minutes)	Sampling Equipment[a]	Sampling Location and Number of Samples
Background Air Samples (Offsite or at the Perimeter of the Site)					
G148BKA*yy*	G148-BKA-##	10	Minimum of 480 minutes, possibly longer	Gillian Aircon 2 25-mm dia., 0.8-µm MCE	Background, upwind and offsite or upwind at the perimeter of the site. Try to position this sampling location to be 30 degrees away from the prevailing wind line. One background sample is collected per day of sampling activities.
Aggressive Air Samples (Rounds 1, 2, 3, etc. – Indoors and Outdoors Around Building Perimeter)[b]					
G148AA*nyy*	G148-AA*n*-AH-##	10	Minimum of 400	Gillian Aircon 2 25-mm dia., 0.8-µm MCE	Inside structure to be sampled, with each high flow rate pump (10 L/min) collocated with one low flow rate pump (3 L/min). Pump sets will be dispersed throughout the structure. The number of these collocated pump sets to be deployed within a structure will vary depending upon structure size and the number of rooms. As a general rule, deploy: at least five sets within a structure that is a single room; at least one set per room for a structure with up to five rooms; and at least one set per room in five (or more) rooms chosen to be representative for a structure with more than five rooms. Pump sets deployed within the same room will be dispersed throughout the room.
	G148-AA*n*-AL-##	3	Minimum of 400	SKC Universal PCXR8 25-mm dia., 0.8-µm MCE	

TABLE 1
AGGRESSIVE AIR AND ACTIVITY-BASED AIR SAMPLING EVENTS
SAMPLES, SAMPLING EQUIPMENT AND SPECIFICATIONS, AND SAMPLING LOCATIONS

Station ID	Sample Designation	Pump Flow Rate (L/min)	Sampling Duration (minutes)	Sampling Equipment[a]	Sampling Location and Number of Samples
G148AA*nyy*	G148-AA*n*-B-##*	NA	NA	Stainless steel spoon, stainless steel bowl, and either one 8-ounce glass jar or three one-gallon re-sealable plastic bags	Inside structure to be sampled. Look for places where bulk material has accumulated or settled; this material is collected as either a grab or multi-point composite sample in an 8-ounce jar. If pure or almost pure vermiculite attic insulation (VAI) is present in bulk or in containers, collect this material as either a grab or multi-point composite sample in the plastic bags. Collect up to two bulk material samples (including any VAI samples) per aggressive air sampling round.
G148AA*nyy*	G148-AA*n*-D-##*	2	Minimum of 2 minutes per 100 cm^2 area	SKC Universal PCXR8 25-mm dia., 0.45-μm MCE, with plastic tube sampling nozzle	Inside structure to be sampled. Each microvacuum dust sample will consist of a grab or multi-point (multi-aliquot) composite collected after the aggressive air sampling is completed. The sampling area for each grab sample or for each of the composite sample aliquots will be at least 100 cm^2. The number, type (grab or composite), and locations of microvacuum dust samples to be collected will be determined in the field, and may involve collecting a three-point composite dust sample from the floor surrounding each of the collocated pump sets located inside the building structure.

TABLE 1
AGGRESSIVE AIR AND ACTIVITY-BASED AIR SAMPLING EVENTS
SAMPLES, SAMPLING EQUIPMENT AND SPECIFICATIONS, AND SAMPLING LOCATIONS

Station ID	Sample Designation	Pump Flow Rate (L/min)	Sampling Duration (minutes)	Sampling Equipment[a]	Sampling Location and Number of Samples
G148AA*nyy*	G148-AA*n*-PH-##	10	Minimum of 400	Gillian Aircon 2 25-mm dia., 0.8-μm MCE	Outside and surrounding the perimeter of the structure to be sampled. Sampling will occur concurrently with the aggressive air sampling occurring inside the structure. There will be a minimum of one upwind and three downwind sampling locations (the background air sampling location may serve as the upwind location, if necessary). Try to position the upwind sampling location to be 30 degrees away from prevailing wind line, and on the opposite side of the prevailing wind line as the background air sampling location. In addition, array the downwind sampling locations in a 180 degree arc downwind of the structure.
Activity-Based Samples (Round 1, 2, 3, etc. – Sweeping, Raking, ATV-Riding, Bicycling, Running Outdoors, etc.)[c]					
G148AB*nyy*	G148-AB*n*-AH-##	10	Minimum of 120	SKC QuickTake 30 25-mm dia., 0.8-μm MCE	Outside, within the breathing zone of the person conducting the activity. One high flow rate pump (10 L/min) will be collocated with one low flow rate pump (3 L/min). Both pumps will be attached to the person using a backpack or similar device, with the openings of the cassettes positioned as close to the person's breathing zone as possible.
	G148-AB*n*-AL-##	3	Minimum of 120	SKC Universal PCXR8 25-mm dia., 0.8-μm MCE	

TABLE 1
AGGRESSIVE AIR AND ACTIVITY-BASED AIR SAMPLING EVENTS
SAMPLES, SAMPLING EQUIPMENT AND SPECIFICATIONS, AND SAMPLING LOCATIONS

Station ID	Sample Designation	Pump Flow Rate (L/min)	Sampling Duration (minutes)	Sampling Equipment[a]	Sampling Location and Number of Samples
G148AB*nyy*	G148-AB*n*-B-##*	NA	NA	Stainless steel spoon, stainless steel bowl, and either one 8-ounce glass jar or three one-gallon re-sealable plastic bags	Outside, within the area designated for conducting the activity. Collect a bulk material sample from the piles of debris generated during the activity. If piles are not generated, collect bulk material from the designated area by digging at the ground surface. Collect the sample as either a grab or multi-point composite sample in an 8-ounce jar. If pure or almost pure vermiculite attic insulation (VAI) is present, collect this material as either a grab or multi-point composite sample in the plastic bags. Collect one bulk material sample (including VAI samples) per activity-based air sampling round.
G148AB*nyy*	G148-AB*n*-D-##*	2	Minimum of 2 minutes per 100 cm^2 area	SKC Universal PCXR8 25-mm dia., 0.45-µm MCE, with plastic tube sampling nozzle	Outside, within the area designated for conducting the activity. Each microvacuum dust sample will consist of a grab or multi-point (multi-aliquot) composite collected after the activity-based air sampling is completed. The sampling area for each grab sample or for each of the composite sample aliquots will be at least 100 cm^2. The number, type (grab or composite), and locations of microvacuum dust samples to be collected will be determined in the field, and may involve collecting one three (or more)-point composite dust sample from the ground within the area designated for conducting the activity.

TABLE 1
AGGRESSIVE AIR AND ACTIVITY-BASED AIR SAMPLING EVENTS
SAMPLES, SAMPLING EQUIPMENT AND SPECIFICATIONS, AND SAMPLING LOCATIONS

Station ID	Sample Designation	Pump Flow Rate (L/min)	Sampling Duration (minutes)	Sampling Equipment[a]	Sampling Location and Number of Samples
G148AB*nyy*	G148-AB*n*-PH-##	10	Minimum of 120	Gillian Aircon 2 25-mm dia., 0.8-µm MCE	Outside and surrounding the area designated for conducting the activity. Each high flow rate pump (10 L/min) will be collocated with one low flow rate pump (3 L/min) at each sampling location. There will be a minimum of one upwind and three downwind sampling locations (the background air sampling location may serve as the upwind location, if necessary). Try to position the upwind sampling location to be 30 degrees away from prevailing wind line, and on the opposite side of the prevailing wind line as the background air sampling location. In addition, array the downwind sampling locations in a 180 degree arc downwind of the designated area.
	G148-AB*n*-PL-##	3	Minimum of 120	SKC Universal PCXR8 25-mm dia., 0.8-µm MCE	
Additional Bulk Material and Vermiculite Attic Insulation (VAI) Samples					
G148BS*yy*	G148-BS-##	NA	NA	Stainless steel spoon, stainless steel bowl, and either one 8-ounce glass jar or three one-gallon re-sealable plastic bags. A hand auger may also be used to excavate the material chosen for sampling.	Location is determined in the field. Look for places where bulk material has accumulated or settled; collect bulk material by digging at the ground surface using either a spoon or a hand auger. The material is collected as either a grab or multi-point composite sample in an 8-ounce jar. If pure or almost pure vermiculite attic insulation (VAI) is present in bulk or in containers, collect this material as either a grab or multi-point composite sample in the plastic bags. Collect up to two bulk material samples (including any VAI samples) per event.

Notes:

a = Specific makes and models of air pumps are listed in this column; other makes and models may be used as long as they are capable of providing air flow at the designated flow rates, with the same precision as the listed pumps, and over the planned sampling durations.

TABLE 1
AGGRESSIVE AIR AND ACTIVITY-BASED AIR SAMPLING EVENTS
SAMPLES, SAMPLING EQUIPMENT AND SPECIFICATIONS, AND SAMPLING LOCATIONS

Notes:

b	=	There may be multiple aggressive air sampling rounds, the final number of which will be determined in the field.
c	=	There will be multiple activity-based outdoor air sampling rounds. The specific activity chosen and number of rounds will be determined in the field.
*	=	If there is not enough dust and debris for collecting bulk material and VAI samples, microvacuum dust samples may be collected instead.
##	=	Sequential sample number to be selected in the field; all samples will be assigned unique numbers as part of their sample designations. No two samples will share the same sequential sample number.
AA***n***	=	Aggressive air sampling round ***n***, where ***n*** = 1, 2, 3, etc.
AB***n***	=	Activity-based air sampling round ***n***, where ***n*** = 1, 2, 3, etc.
AH	=	High flow rate air sample
AL	=	Low flow rate air sample
B	=	Bulk material sample. This sample may consist of debris, soil, or vermiculite attic insulation (VAI).
BKA	=	Background air sample
BS	=	Bulk material sample not associated with a particular aggressive air or activity-based sampling round. This sample may consist of debris, soil, or vermiculite attic insulation (VAI).
cm^2	=	Square centimeter
D	=	Grab or composite microvacuum dust sample.
dia.	=	Diameter
G148	=	Vermiculite Exfo Palmetto GAO 148
ID	=	Identification
L/min	=	Liters per minute
MCE	=	Mixed cellulose ester membrane filter contained in a cassette
µm	=	Micrometer
mm	=	Millimeter
n	=	A number (1, 2, 3, etc.) that designates the aggressive air sampling round, or, a number (1, 2, 3, etc.) that designates the activity-based sampling round.
NA	=	Not applicable
PH	=	High flow rate perimeter air sample
PL	=	Low flow rate perimeter air sample
VAI	=	Vermiculite attic insulation
yy	=	Sequential station location number to be selected in the field; all station locations will be assigned unique numbers as part of their station IDs. Samples that share the same station location (even if the samples are not collected at the same time), however, will have the same station ID.

TABLE 2
AGGRESSIVE AIR AND ACTIVITY-BASED AIR SAMPLING EVENTS
FIELD QUALITY CONTROL SAMPLES

Sample Designation	Sample Type	Rationale
G148-LOT-08-##	Lot Blank for 0.8 µm MCE membrane filter cassettes	Determine whether the sample-collection media are affecting the analytical results for air samples. **Two lot blanks will be collected per lot of cassettes. These blanks should not be taken to the site to avoid potential exposure to contamination.**
G148-LOT-45-##	Lot Blank for 0.45 µm MCE membrane filter cassettes	Determine whether the sample-collection media are affecting the analytical results for microvacuum dust samples. **Two lot blanks will be collected per lot of cassettes. These blanks should not be taken to the site to avoid potential exposure to contamination.**
G148-FB-08-##	Field Blank for 0.8 µm MCE membrane filter cassettes	Determine whether the sample-collection media are being contaminated through field handling (but not including collecting air samples) and shipping of the media, thus affecting the analytical results for air samples. **One field blank will be collected per 20 samples and per lot of cassettes.** [a]
G148-FB-45-##	Field Blank for 0.45 µm MCE membrane filter cassettes	Determine whether the sample-collection media are being contaminated through field handling (but not including collecting microvacuum dust samples) and shipping of the media, thus affecting the analytical results for microvacuum dust samples. **One field blank will be collected per 20 samples and per lot of cassettes.**
(Original Sample Designation)-DUP	Field Duplicate Sample	Measure both field and laboratory precision. **One field duplicate sample of each type of sample matrix will be collected per sampling event or for every 20 samples, whichever is more frequent.** Field duplicate air samples will be collected during the same time period and from as close to the same air space as possible as the original sample, using identical but separate sampling equipment. Field duplicate samples of microvacuum dust and bulk material will be collected immediately after collecting the original sample and from as close to the same location as possible, using identical but all new sampling equipment. Sample matrices are as follows: (1) background air; (2) aggressive air high flow rate indoor air; (3) aggressive air low flow rate indoor air; (4) aggressive air bulk material; (5) aggressive air microvacuum dust; (6) aggressive air high flow rate perimeter air; (7) activity-based high flow rate breathing zone air; (8) activity-based low flow rate breathing zone air; (9) activity-based bulk material; (10) activity-based microvacuum dust; (11) activity-based high flow rate upwind perimeter air, (12) activity-based low flow rate upwind perimeter air,

TABLE 2
AGGRESSIVE AIR AND ACTIVITY-BASED AIR SAMPLING EVENTS
FIELD QUALITY CONTROL SAMPLES

Sample Designation	Sample Type	Rationale
		(13) activity-based high flow rate downwind perimeter air, (14) activity-based low flow rate downwind perimeter air, and (15) additional bulk material.

Notes:

a	=	The number of field blanks anticipated for the 0.8 µm cassettes will be calculated by counting each set of collocated high-flow-rate and low-flow-rate pumps as one sample.
##	=	Sequential sample number to be selected in the field; all samples will be assigned unique numbers as part of their sample designations. No two samples will share the same sequential sample number.
-DUP	=	Field duplicate sample
G148-	=	Vermiculite Exfo Palmetto GAO 148
-FB-08-	=	Field blank for 0.8-µm MCE membrane filter cassettes
-FB-45-	=	Field blank for 0.45-µm MCE membrane filter cassettes
-LOT-08-	=	Lot blank for 0.8-µm MCE membrane filter cassettes
-LOT-45-	=	Lot blank for 0.45-µm MCE membrane filter cassettes
MCE	=	Mixed cellulose ester
µm	=	Micrometer

TABLE 3
AGGRESSIVE AIR AND ACTIVITY-BASED AIR SAMPLING EVENTS ANALYTICAL PARAMETERS AND METHODS, REQUIRED SAMPLE CONTAINERS, PRESERVATION METHODS, AND HOLDING TIMES

Item Number[a]	Analytical Parameter	Matrix	Analytical Method	Number and Type of Sample Container or Sampling Media	Sample Preservation Method	Sample Holding Time
1	Asbestos	Soil or bulk material	CARB Method 435[b]	One 8-ounce glass jar with Teflon-lined lid	None; store in a cool, dark location	Indefinite
2	Water (Moisture) Content	Soil or bulk material	ASTM Method D4643-00[c]		None; store in a cool, dark location	As soon as possible
3	Particle Size Distribution	Soil or bulk material	ASTM Method D422-63 (2007)[d]		None; store in a cool, dark location	Indefinite
4	Asbestos	Vermiculite[e]	EPA/600/R-04/004[f]	Three one-gallon re-sealable plastic bags	None; store in a cool, dark location	Indefinite
5	Asbestos	Microvacuumed dust	ASTM Method D5755-95[g]	One 25–mm diameter, 0.45-µm MCE membrane filter cassette and short (about 1-inch-long) plastic tube-nozzle with a 0.25-inch inner diameter	None; store in a cool, dark location	Indefinite
6	Asbestos	Air, asbestos to 0.001 s/cc sensitivity	ISO Method 10312: 1995[h]	One 25–mm diameter, 0.8-µm MCE membrane filter cassette	None; store in a cool, dark location	Indefinite
7	Asbestos	Air, asbestos to 0.0001 s/cc sensitivity	ISO Method 10312: 1995[h]	One 25–mm diameter, 0.8-µm MCE membrane filter cassette	None; store in a cool, dark location	Indefinite

Notes:

a = Refer to the following for information on "Item Number" and specific requirements on the application of the analytical methods listed above to the analysis of the collected samples: United States Environmental Protection Agency (EPA). 2009. Region 4 Superfund Division. Nardina Turner, Technical Representative. *Request for Analytical Services*. June 18; and any subsequent requests for analytical services.

b = California Environmental Protection Agency, Air Resources Board (CARB). 1991. *Method 435, Determination of Asbestos Content of Serpentine Aggregate*. Adopted June 6. (Note: This method will be modified for use according to requirements given in the reference given in footnote "a" above).

c = American Society for Testing and Materials (ASTM). 2000. *D4643-00 Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method.* March. (Note: This method is the one cited in the EPA request for analytical services [see Footnote "a" above]. It is, however, an older version of the standard test method. The most recent version

TABLE 3
AGGRESSIVE AIR AND ACTIVITY-BASED AIR SAMPLING EVENTS ANALYTICAL PARAMETERS AND METHODS, REQUIRED SAMPLE CONTAINERS, PRESERVATION METHODS, AND HOLDING TIMES

Notes:

is designated D4643-08.)

d = ASTM International. 2007. *D422-63 (2007) Standard Test Method for Particle-Size Analysis of Soils.* October.

e = This matrix designation is reserved for submission of solid material suspected of being pure or almost pure vermiculite attic insulation (VAI) that has been expanded by heating the vermiculite mineral.

f = United States Environmental Protection Agency (EPA). 2004. Office of Research and Development. *Research Method for Sampling and Analysis of Fibrous Amphibole in Vermiculite Attic Insulation.* EPA/600/R-04/004. January. This method can be found at the following web address: http://www.epa.gov/nrmrl/pubs/600r04004/600r04004.pdf.

g = American Society for Testing and Materials (ASTM). 1995. *D5755-95 Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Concentrations.* (Note: This method is the one cited in the EPA request for analytical services [see Footnote "a" above]. It is, however, a historical standard that has been superseded. The most recent version is: ASTM International. 2003. *D5755-03 Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Surface Loading.* April 10.)

h = International Organization for Standardization (ISO). 1995. *ISO 10312: 1995 - Ambient Air – Determination of Asbestos Fibers - Direct Transfer Transmission Electron Microscopy Method.* (Note: The following method may also be applied according to the specifications given in the references given in footnote "a" above: International Organization for Standardization (ISO). 1999. *ISO 13794: 1999 - Ambient Air – Determination of Asbestos Fibers – Indirect-Transfer Transmission Electron Microscopy Method)*

MCE = Mixed cellulose ester

µm = Micrometer

mm = Millimeter

APPENDIX C

SITE-SPECIFIC QUALITY ASSURANCE PROJECT PLAN (SHORT FORM)

(16 Pages)

DRAFT
QUALITY ASSURANCE PROJECT PLAN (SHORT FORM)
AGGRESSIVE AIR AND ACTIVITY-BASED AIR SAMPLING EVENT

VERMICULITE EXFO PALMETTO GAO 148
WOODRUFF, SPARTANBURG COUNTY, SOUTH CAROLINA

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
Region 4
Atlanta, GA 30303

Contract No.	:	EP-W-05-054
TDD No.	:	TTEMI-05-003-0078
Date Prepared	:	November 16, 2009
EPA Task Monitor	:	Leonardo Ceron
Telephone No.	:	(404) 562-9129
Prepared by	:	Tetra Tech Inc.
START III Project Manager	:	John Schendel
Telephone No.	:	(678) 775-3089

Prepared by	Reviewed by	Approved by
Jessica A. Vickers	John Schendel	Andrew F. Johnson
Jessica Vickers START III Chemist	John Schendel START III Technical Reviewer	Andrew F. Johnson START III Program Manager

CONTENTS

TABLES

QUALITY ASSURANCE PROJECT PLAN (SHORT FORM)
U.S. ENVIRONMENTAL PROTECTION AGENCY, REGION 4 & TETRA TECH INC.
SUPERFUND TECHNICAL ASSESSMENT AND RESPONSE TEAM CONTRACT NO. EP-W-05-054

Site Name:	Vermiculite Exfo Palmetto GAO 148 (GAO 148)	**City, County:** Woodruff, Spartanburg County	**State:** South Carolina
Prepared By:	Tetra Tech, Inc. (Tetra Tech)	**Date:** November 16, 2009	
Approved By:	John Schendel **Date:** 11/16/09	**Signature:** John Schendel	
Title:	Tetra Tech Project Manager		
Approved By:	Jessica Vickers **Date:** 11/16/09	**Signature:** Jessica A. Vickers	
Title:	Tetra Tech Quality Assurance (QA) Manager		
Approved By:	Andrew Johnson **Date:** 11/16/09	**Signature:** Andrew Johnson	
Title:	Tetra Tech START III Program Manager		
Approved By:	Leonardo Ceron **Date:**	**Signature:**	
Title:	EPA On-Scene Coordinator (OSC) and EPA Region 4 QA Manager's Designated Approving Official (DAO)		

1.0 PROJECT INFORMATION

1.1 Distribution List:

EPA Region 4:

Leonardo Ceron, EPA OSC and DAO
Katrina Jones, EPA Project Officer

Tetra Tech:

John Schendel, Project Manager
Randy Mayer, Field Team Leader
Field Team Members
Angel Reed, Tetra Tech Document Control Coordinator

EPA Environmental Response Team (ERT):

Personnel from EPA ERT and the EPA ERT Response Engineering and Analytical Contract (REAC) will not participate in this sampling event.

1.2 Project/Task Organization

Leonardo Ceron, U.S. Environmental Protection Agency (EPA) OSC, will serve as the EPA Task Monitor for the activities described in this Quality Assurance Project Plan (QAPP). John Schendel of Tetra Tech will serve as the Tetra Tech project manager and is responsible for maintaining an approved version of this QAPP. Jessica Vickers will serve as the Tetra Tech QA manager and is responsible for providing Tetra Tech approval of this QAPP. Specific Tetra Tech field personnel will be identified before mobilization, including a principal professional as defined under the Superfund Technical Assessment and Response Team (START III) Contract No. EP-W-05-054.

1.3 Problem Definition/Background:

☐ Description attached.

☒ Description in referenced reports:

Title	Date
Sampling and Analysis Plan (SAP), Aggressive Air and Activity-Based Air Sampling Event	November 16, 2009

1.4 Project/Task Description:

☐ Description attached.

☒ Description in referenced reports:

	Title	Date
Description in referenced reports:	SAP, Aggressive Air and Activity-Based Air Sampling Event	November 16, 2009

Schedule: The field sampling event is scheduled to occur during the period of November 30 to December 4, 2009.

1.5 Quality Objectives and Criteria for Measurement Data:

Identification of the seven steps of the data quality objectives (DQO) process: DQOs were established for the Vermiculite Exfo Palmetto GAO 148 site to define the quantity and quality of the data to be collected to support the objectives of the SAP. DQOs were developed using the seven-step process outlined in the following EPA guidance documents: "EPA Requirements for Quality Assurance Project Plans," EPA QA/R-5, March 2001; "Guidance for Quality Assurance Project Plans," EPA QA/G-5, December 2002; and "Guidance on Systematic Planning Using the Data Quality Objectives Process," EPA QA/G-4, February 2006.

Step 1: State the Problem

Stakeholders: Include: EPA, current owner of the GAO 148 site, and local community

Site History/Conceptual Site Model: The site history and background presented below is based on a site visit conducted by EPA and START personnel on October 28, 2009, and through e-mail and telephone communication with the EPA OSC. The GAO 148 site is located at 13101 Highway 221, Woodruff, Spartanburg County, South Carolina, 29388. The geographic coordinates for the site are latitude 34.6977 degrees north and longitude -81.9988 degrees west. The site consists of a large building, which includes: offices; and open air portions housing an exfoliation furnace, several large bays, and a cement mixing plant. Several piles of material are also located on the property. Some portions of the property are paved. The facility currently receives vermiculite concentrate from imported and local sources and expands the concentrate for packaging and shipment offsite. Some portions of the original property have been redeveloped including the construction of additional buildings.

Sampling at the site has been conducted in the past, including on June 6, 2001. Based on information gathered regarding the GAO 148 site, EPA has concluded that further investigation is required at the site.

Statement of Problem: Sampling and laboratory analysis will be required to evaluate the presence or absence of asbestos and, if present, to determine whether the asbestos originated from the W.R. Grace vermiculite mine in Libby, Montana.

Step 2: Identify the Goals of the Study	**Study Questions:** The primary objective of the activity-based sampling effort is to evaluate potential human exposures to asbestos from disturbance of materials potentially contaminated with asbestos through conducting specific activities at the GAO 148 site. Sampling at the site will occur during various disturbance-type activities at the site and will include collection of air, bulk material (debris and vermiculite attic insulation [VAI]), and microvacuum dust samples. Sampling will include collection of air samples to establish background levels. In addition, weather will be monitored to establish values for variables such as wind direction and speed. Samples will be submitted for analysis for asbestos, water (moisture) content, and particle size distribution. These activities will assist in evaluating the presence or absence of asbestos at the site. If asbestos is present, a subsequent objective of the sampling event is to determine whether the asbestos identified is the type that originated from the W.R. Grace vermiculite mine in Libby, Montana. A final objective will be to support an assessment and evaluation of the need for further investigation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). **Decision Statements:** Sampling and laboratory analysis will be conducted to determine: (1) the presence or absence of asbestos fibers in the collected samples, (2) the concentrations of asbestos fibers in air in the study areas during the aggressive air and activity-based air sampling activities, (3) whether human exposure to asbestos through inhalation may potentially occur during typical activities at the site, (4) whether potential background sources of asbestos are contributing to air quality in the vicinity of the site, and (5) whether on-site asbestos originated from the vermiculite mine in Libby, Montana. Ultimately, the data will be used to assess whether or not further action is required at the site; the assessment approach is beyond the scope of this project.
Step 3: Identify Information Inputs	**Inputs:** Site history contained in Section 2.0 of the SAP dated November 16, 2009.
Step 4: Define Study Boundaries	**Spatial Boundary:** Site features include a large building, which includes: offices; and open air portions housing an exfoliation furnace, several large bays, and a cement mixing plant. Several piles of material are also located on the property. Some portions of the property are paved. Some portions of the original property have been redeveloped including the construction of additional buildings (see Appendix A, Figure 2 of the SAP dated November 16, 2009). **Temporal Boundaries:** Sampling is scheduled for the week of November 30 to December 4, 2009. The temporal boundaries for sampling extend from when EPA initiates activities until EPA declares activities complete.
Step 5: Develop the Analytical Approach	**Analytical Methods:** The analytical parameters and associated laboratory analytical methods that will be used for this project are listed in Section 5.0 and Appendix B, Table 3 of the SAP dated November 16, 2009. See also Table 2 of this QAPP. **Comparison Criteria:** Analytical results will be compared with background air sample results and criteria listed in Section 4.0 of the SAP dated November 16, 2009. **Decision Rules:** Comparison of data as described above will allow the Decision Statements No. 1 through No. 5 listed in Step 2 to be addressed.
Step 6: Specify Performance or Acceptance Criteria	Initial acceptance of the laboratory analytical data will be determined through data validation conducted by the QA Technical Support contractor, Shaw Environmental and Infrastructure. A data validation report will be prepared that will indicate any rejected data and the reasons for their rejection, and will present the limitations to the data based upon the review of the data quality. Field quality control samples will be collected during the sampling event to monitor sampling precision and assess the cleanliness of the air sampling media and other sampling equipment. Table 2 of Appendix B of the SAP dated November 16, 2009 summarizes the sample designations, types, and sampling rationales for all proposed field quality control samples. See also Table 2 of this QAPP.

Step 7: Develop the Plan for Obtaining Data	**Optimized Design:** The sampling approach, including determining the type and number of asbestos samples collected, will be biased to identify source locations. The samples to be collected and their proposed locations are summarized and described in the SAP, dated November 16, 2009 (specifically, see Appendix B, Table 1 of the SAP).

1.6 Special Training/Certification Requirements:

☒ OSHA 29 CFR ☐ Special Equipment/Instrument Operator (describe below): ☒ Other (describe below):

Special Requirements:

Special training and health monitoring requirements are required for personnel working at sites suspected of containing asbestos, including an asbestos awareness training class and Asbestos Workers medical surveillance.
Training, including record retention, will be conducted in accordance with Section H.2 of EPA START III Contract No. EP-W-05-054 as well as the Tetra Tech START Contract-Level QAPP dated February 2006 (Sections 1.5 and 1.6). In addition, the Tetra Tech Director of Health and Safety maintains a database of personnel training.

1.7 Documentation and Records:

The most current version of this QAPP will be distributed to the entire distribution list presented in Section 1.1. The Tetra Tech project manager will be responsible for maintaining the most current version of this QAPP and for distributing it to all personnel and parties involved in the field effort. Field records that may be generated include the following:

☒	Chains-of-Custody Forms	☒	Health and Safety Plan
☒	Field Instrument Calibration Logs	☒	Photographic log
☒	Field Monitoring and Screening Results	☒	Site Logbook
☐	Soil Borings and Well Logs	☒	Site Maps and Drawings

Field documentation and records will be generated and maintained in accordance with the requirements presented in the following EPA Region 4 Science and Ecosystem Division (SESD) standard operating procedures (SOP), found in *Field Branches Quality System and Technical Procedures*: *Control of Records (SESDPROC-002-R4)*, February 2008; *Sample and Evidence Management (SESDPROC-005-R1)*, November 2007; and *Logbooks (SESDPROC-010-R3)*, November 2007. These documents can be found at the following web address: http://www.epa.gov/region4/sesd/fbqstp/index.html.

Analytical parameters for the assessment at the site include those methods listed in Section 5.0 and Appendix B, Table 3 of the SAP dated November 16, 2009.

The formal deliverables for EPA associated with this project are specified in the EPA Technical Direction Document. Draft and final reports will be prepared to summarize field activities and findings and present field and laboratory analytical results. All project records under Tetra Tech's control will be maintained and retained in accordance with the requirements of EPA START III Contract No. EP-W-05-054.

2.0 DATA GENERATION AND ACQUISITION

2.1 Sampling Process Design:

The SAP, dated November 16, 2009, presents details on the types of and determining the numbers of samples to be collected, sample matrices, sample locations, and laboratory analytical methods (see Sections 3.0, 4.0, 5.0, and Appendix B of the SAP). The rationale for this sampling process design is based on the DQO process discussed in Section 1.5 of this QAPP. Samples submitted to the EPA Region 4-procured laboratory will be analyzed for asbestos, water (moisture) content, and particle size distribution.

2.2 Sample Method Requirements:

Matrices	Sampling Method	EPA and Tetra Tech Standard Operating Procedures and Guidance
Soil or bulk material, VAI, microvacuumed dust, and air	Refer to the SAP dated November 16, 2009 (and references cited therein) for all sample collection details, including requested laboratory analytical methods.	Refer to the following guidance documents, as applicable (see SAP dated November 16, 2009): EPA. 2007 through 2009. Region 4, SESD SOPs, found in *Field Branches Quality System and Technical Procedures*: *Global Positioning System (SESDPROC-110-R2)*, November 2007 *Ambient Air Sampling (SESDPROC-303-R1)*, November 2007 *Soil Sampling (SESDPROC-300-R1)*, November 2007 *Waste Sampling (SESDPROC-302-R1)*, November 2007 *Bulk Sampling for Asbestos (SESDGUID-104-R0)*, August 2009 *Field Sampling Quality Control (SESDPROC-011-R2)*, January 2008 *Packing, Marking, Labeling and Shipping of Environmental and Waste Samples (SESDPROC-209-R1)*, November 2007 *Management of Investigation Derived Waste (SESDPROC-202-R1)*, November 2007. These documents can be found at the following web address: http://www.epa.gov/region4/sesd/fbqstp/index.html. EPA. 2008. Asbestos Committee of the Technical Review Workgroup of the Office of Solid Waste and Emergency Response (OSWER). *Framework for Investigating Asbestos-Contaminated Superfund Sites*. OSWER Directive #9200.0-68. September. EPA. 2007. ERT. *Activity-Based Air Sampling for Asbestos*. SOP No. 2084, Rev. No. 0.0. May 10. EPA. 1994. ERT. *Asbestos Sampling*. SOP No. 2015, Rev. No. 0.0. November 17 American Society for Testing and Materials (ASTM). 1995. *D5755-95 Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Concentrations.* (Note: This is a historical standard that has been superseded. The most recent version is: ASTM International. 2003. *D5755-03 Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Surface Loading.* April 10.) EPA. 2004. Office of Research and Development. *Research Method for Sampling and Analysis of Fibrous Amphibole in Vermiculite Attic Insulation.* EPA/600/R-04/004. January. This method can be found at the following web address: http://www.epa.gov/nrmrl/pubs/600r04004/600r04004.pdf. A list of applicable Safe Work Practices (SWP) is included in the Health and Safety Plan (HASP), which will be available on site.

Other Sample Method Requirements: The Tetra Tech field team leader, in coordination with the EPA OSC, will be responsible for identifying failures in sampling and field measurement systems, overseeing any corrective actions, ensuring that the corrective actions are documented in site logbooks and other appropriate records, and assessing the effectiveness of corrective actions. Field decontamination will be conducted in accordance with the procedures provided in the EPA Region 4, SESD SOP, found in *Field Branches Quality System and Technical Procedures*: *Field Equipment Cleaning and Decontamination (SESDPROC-205-R1)*, November 2007, available at the following web address: http://www.epa.gov/region4/sesd/fbqstp/index.html. Equipment required for this sampling event includes the equipment listed in Table 3 of this QAPP and the personal protective equipment (PPE) identified in the HASP (Appendix D of the SAP dated November 16, 2009).

2.3 Sample Handling and Custody Requirements:

Sample handling and chain-of-custody record keeping will be conducted in accordance with EPA Region 4, SESD SOPs, found in *Field Branches Quality System and Technical Procedures*: *Sample and Evidence Management (SESDPROC-005-R1),* November 2007; and *Packing, Marking, Labeling, and Shipping of Environmental and Waste Samples (SESDPROC-209-R1)*, November 2007, available at the following web address: http://www.epa.gov/region4/sesd/fbqstp/index.html. Once collected, all samples will be placed in a custody-sealed container and held in a secure location. The Tetra Tech field team leader or his designee will ensure that custody of samples is maintained until they are shipped to the laboratory. Chain-of-custody and associated field records will be used to document the samples from collection through delivery to the laboratory. Samples will be processed using EPA Scribe software.

Also refer to Section 2.3 of the Tetra Tech START Contract-Level QAPP dated February 2006.

2.4 Analytical Method Requirements:

The analytical parameters and associated laboratory analytical methods that will be used for this project are presented in Section 5.0 and Appendix B, Table 3 of the SAP, dated November 16, 2009.

The EPA Region 4-procured analytical data packages will be validated by the QA Technical Support contractor, Shaw Environmental and Infrastructure.

A 60-day turnaround time is requested for the laboratory to submit results to the EPA. Validation of the analytical data packages is anticipated to be completed within 30 days of receipt of laboratory data packages, though that time frame may vary. Within 14 business days after the validated analytical data is received, Tetra Tech will conduct a cursory review of the validated data against the chain-of-custody records to ensure that results for all samples are received. The validated data will also be reviewed to determine whether any data are rejected and whether any data qualifiers assigned during the validation process affect the usability of the data, as defined in Section 1.5 of this QAPP. Once the cursory review is completed, Tetra Tech will notify the OSC of problems encountered, if any. Tetra Tech will submit the draft report to EPA within the timeframe negotiated with the OSC.

2.5 Quality Control Requirements:

Quality control requirements for field sampling and monitoring are provided in the following:

EPA. 2008. Region 4 SESD SOP, found in *Field Branches Quality System and Technical Procedures: Field Sampling Quality Control (SESDPROC-011-R2).* January. Available at the following web address: http://www.epa.gov/region4/sesd/fbqstp/index.html.

EPA. 2008. Asbestos Committee of the Technical Review Workgroup of OSWER. *Framework for Investigating Asbestos-Contaminated Superfund Sites.* OSWER Directive #9200.0-68. September.

EPA. 2007. ERT. *Activity-Based Air Sampling for Asbestos.* SOP No. 2084, Rev. No. 0.0. May 10.

EPA. 1994. ERT. *Asbestos Sampling.* SOP No. 2015, Rev. No. 0.0. November 17

ASTM. 1995. *D5755-95 Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Concentrations.* (Note: This is a historical standard that has been superseded. The most recent version is: ASTM International. 2003. *D5755-03 Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Surface Loading.* April 10.)

EPA. 2004. Office of Research and Development. *Research Method for Sampling and Analysis of Fibrous Amphibole in Vermiculite Attic Insulation.* EPA/600/R-04/004. January. This method can be found at the following web address: http://www.epa.gov/nrmrl/pubs/600r04004/600r04004.pdf.

Quality control requirements for analytical methods are presented in the last two citations listed above and in the following:

EPA. 2009. Region 4 Superfund Division. Nardina Turner, Technical Representative. *Request for Analytical Services.* June 18.

California Environmental Protection Agency, Air Resources Board (CARB). 1991. *Method 435, Determination of Asbestos Content of Serpentine Aggregate.* Adopted June 6.

ASTM. 2000. *D4643-00 Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method.* March. (Note: This is an older version of the standard test method. The most recent version is designated D4643-08.)

ASTM International. 2007. *D422-63 (2007) Standard Test Method for Particle-Size Analysis of Soils.* October.

International Organization for Standardization (ISO). 1995. *ISO 10312: 1995 - Ambient Air – Determination of Asbestos Fibers - Direct Transfer Transmission Electron Microscopy Method.*

ISO. 1999. *ISO 13794: 1999 - Ambient Air – Determination of Asbestos Fibers – Indirect-Transfer Transmission Electron Microscopy Method.*

Field quality control samples will include: lot blanks, field blanks, and field duplicate samples. The rationale and frequencies for collecting these field quality control samples are presented in Appendix B, Table 2 in the SAP, dated November 16, 2009. All field quality control samples will be submitted for analysis for the appropriate parameters as listed in Appendix B, Table 3 of the SAP dated November 16, 2009. Laboratory quality control samples – if any - including performance evaluation samples, will be submitted directly to the laboratory by EPA or prepared by the laboratory.

2.6 Instrument/Equipment Testing, Inspection, and Maintenance Requirements:

For applicable instrument testing, inspection, and maintenance requirements for field monitoring and sampling, refer to the EPA Region 4, SESD SOPs, found in *Field Branches Quality System and Technical Procedures*: *Equipment Inventory and Management (SESDPROC-108-R3)*, April 2009; *Global Positioning System (SESDPROC-110-R2)*, November 2007; and *Field Equipment Cleaning and Decontamination (SESDPROC-205-R1)*, November 2007; all available at the following web address: http://www.epa.gov/region4/sesd/fbqstp/index.html. In addition, refer to manufacturer's operating manuals for further instructions. Table 3 of this QAPP contains a list of field equipment that will be used during this sampling event.

Laboratory instrument testing, inspection, and maintenance requirements are presented in the analytical methods presented in Section 5.0 and Appendix B, Table 3 of the SAP (dated November 16, 2009), the instrument and equipment manufacturer's operating manuals associated with the analytical methods, and the laboratory quality assurance manual.

2.7 Instrument Calibration and Frequency:

For instrument calibration and frequency requirements for field monitoring and sampling, refer to the EPA Region 4, SESD SOP, found in *Field Branches Quality System and Technical Procedures*: *Equipment Inventory and Management (SESDPROC-108-R3)*, April 2009, available at the following web address: http://www.epa.gov/region4/sesd/fbqstp/index.html. In addition, refer to manufacturer's operating manuals for further instructions.

Instrument calibration and frequency requirements for laboratory analytical methods are presented in the analytical methods presented in Section 5.0 and Appendix B, Table 3 of the SAP (dated November 16, 2009), the instrument manufacturer's operating manuals associated with the analytical methods, and the laboratory quality assurance manual.

2.8 Inspection/Acceptance Requirements for Supplies and Consumables:

Supplies and consumables required for this sampling event will be inspected and accepted by the Tetra Tech field team leader or designated field team member and will include those materials and equipment presented in Table 3 of this QAPP and the PPE identified in the HASP (Appendix D of the SAP dated November 16, 2009).

2.9 Non-Direct Measurement Requirements:

Information pertaining to the site (including any photographs, maps, and so forth) has been compiled from file information obtained from EPA and representatives of the current owner of the site. Some of that data and information are presented in the SAP dated November 16, 2009. The extent to which this data and information, if any, are used to achieve the objectives of this project will be determined by Tetra Tech in cooperation with the EPA OSC. Any justifications and qualifications required for the use of these data and information will be provided in the reports generated for this project. Refer to Section 2.9 of the Tetra Tech START Contract-Level QAPP dated February 2006. Any historical information, including data, obtained from Internet websites will be reviewed and cross referenced with information obtained from EPA for accuracy before it is included in the investigation reports.

2.10 Data Management:

All reference materials generated during this investigation and included in the final reports will be submitted to the OSC in electronic format on compact disc, and a Scribe database will be created for the analytical results. The Scribe database will be submitted to the OSC with the final reports. All field-generated data will be managed as part of the permanent field record for the project. All laboratory analytical data will be managed in accordance with the requirements of the methods, as well as the EPA Region 4 policy and applicable federal regulations. Finally, all field-generated data and other records generated or obtained during this project will be managed according to the requirements of EPA START III Contract No. EP-W-05-054 as well as according to Section 2.10 of the Tetra Tech START Contract-Level QAPP dated February 2006.

3.0 ASSESSMENT AND OVERSIGHT

3.1 Assessment and Response Actions:

Field and laboratory audits will not be conducted for this project. All deliverables that Tetra Tech contributes to in whole or in part, including the final reports, will be subject to a corporate two-or three-tiered review process, which includes a technical review, a quality control review, and (for the three-tiered review only) an editorial review. Each reviewer will sign off on a quality control review sheet recording any issues or revisions and how they have been addressed. These reviews will be performed by qualified individuals in accordance with the requirements of EPA START III Contract No. EP-W-05-054.

3.2 Corrective Action:

The Tetra Tech project manager and field team leader, in coordination with the EPA OSC, will be responsible for identifying failures in sampling and field measurement systems, overseeing any corrective actions, ensuring that the corrective actions are documented in site logbooks and other appropriate records, and assessing the effectiveness of corrective actions. Corrective action requirements for sample collection, field measurements, and laboratory analyses are also presented in Section 3.1.2 of the Tetra Tech START Contract-Level QAPP dated February 2006.

3.3 Reports to Management:

Tetra Tech is responsible for notifying the EPA OSC if any circumstances arise during the field investigation that may adversely impact the quality of the data collected.

All formal deliverables to EPA associated with this project will be prepared, reviewed, and distributed in accordance with the requirements of the EPA START III Contract No. EP-W-05-054. In addition, specific reporting requirements are presented in Section 3.2 of the Tetra Tech START Contract-Level QAPP dated February 2006.

4.0 DATA VALIDATION AND USABILITY

4.1 Data Review, Verification, and Validation Requirements:

All field-generated data and records (such as field sampling sheets, global positioning system (GPS) coordinates of sample and other locations, and field logbook notes) will be reviewed for completeness and accuracy by the Tetra Tech project manager, field team leader, and appropriate designees. Field data and records will be reviewed at the end of each day or as soon as possible so that corrective actions, if necessary, can be made before field personnel demobilize from the site.

The EPA Region 4-procured analytical data packages will be validated by the QA Technical Support contractor, Shaw Environmental and Infrastructure.

4.2 Verification and Validation Methods:

All field-generated data will be verified for completeness and validated for accuracy using appropriate methods, including cross-checking transcription of information and data and recalculating results and data that are derived by calculation. Field-generated data will be maintained in the project file and included (as appropriate) in project deliverables in final form after all reviews and associated corrective actions have been completed. The EPA Region 4-procured analytical data packages will be validated by the QA Technical Support contractor, Shaw Environmental and Infrastructure. A data validation report will be prepared that will indicate any rejected data and the reasons for their rejection, and will present the limitations to the data based upon the review of the data quality.

4.3 Reconciliation of the Data to the Project-Specific DQOs:

The Tetra Tech project manager, in cooperation with the EPA OSC and Tetra Tech QA manager, will be responsible for reconciling the data and other project results with the requirements specified in this QAPP, in the SAP (dated November 16, 2009), and by the data users and decision makers. Ultimate acceptance of the data is at the discretion of the EPA OSC. Depending on the nature of how specific data quality indicators do not meet the project's requirements, the data may be discarded, and re-sampling and reanalysis of the subject samples may be required. Re-sampling, reanalysis, or other out-of-scope actions identified to address data quality deficiencies and data gaps will require approval by the EPA OSC, EPA Project Officer, and EPA Contract Officer.

Limitations to the data and data rejection and qualification will be identified during the validation process conducted by the QA Technical Support contractor, Shaw Environmental and Infrastructure. The data will be reviewed to determine whether any data are rejected and whether any data qualifiers or limitations assigned during the validation process affect the usability of the data as defined in Section 1.5 of this QAPP. All final laboratory data packages will be reviewed to evaluate whether the site-specific DQOs, as defined in Section 1.5 of this QAPP, are met. The data will be reconciled with the project-specific DQOs also in accordance with EPA guidance documents, including "Guidance on Systematic Planning Using the Data Quality Objectives Process," EPA QA/G-4, February 2006. The individual responsible for ensuring the success of the analyses and data validation is Leonardo Ceron, EPA Region 4 Special Analytical Services Project Officer.

Also see Section 4.3 of the Tetra Tech START Contract-Level QAPP dated February 2006.

TABLE 1: SAMPLE SUMMARY

Site Name:	Vermiculite Exfo Palmetto GAO 148	**City, County:** Woodruff, Spartanburg County	**State:** South Carolina

No. of Samples	Matrix	Location	Purpose	Depth or other Descriptor	Sampling Method	Requested Analyses	Analytical Methods
ALL MATRICES							
Refer to Section 3.0 and Appendix B of the SAP, dated November 16, 2009, for the proposed field sampling program. Final sampling locations will be based on reconnaissance and observations made while in the field.							
QUALITY CONTROL SAMPLES							
Refer to Appendix B, Table 2 of the SAP, dated November 16, 2009, and to Section 2.5 of this QAPP.							
☒ Refer to the SAP, dated November 16, 2009.							

TABLE 2: PERFORMANCE OR ACCEPTANCE CRITERIA

Site Name:	Vermiculite Exfo Palmetto GAO 148	**City, County:** Woodruff, Spartanburg County	**State:** South Carolina

ALL MATRICES

Analysis	**Analytical Method**
Asbestos (soil or bulk material) Water (moisture) content (soil or bulk material) Particle size distribution (soil or bulk material) Asbestos (VAI) Asbestos (microvacuumed dust) Asbestos (air)	Refer to Section 5.0 and Appendix B, Table 3 of the SAP, dated November 16, 2009, for the proposed analytical methods.

Data Quality Measurements

Accuracy	Field data: Refer to the EPA Region 4, SESD SOPs, found in *Field Branches Quality System and Technical Procedures*: *Equipment Inventory and Management (SESDPROC-108-R3)*, April 2009; *Global Positioning System (SESDPROC-110-R2)*, November 2007; and *Field Sampling Quality Control (SESDPROC-011-R2)*. January 2008; all available at the following web address: http://www.epa.gov/region4/sesd/fbqstp/index.html. Laboratory data: Refer to the analytical methods listed in Section 5.0 and Appendix B, Table 3 of the SAP dated November 16, 2009.
Precision	Field data: Refer to the EPA Region 4, SESD SOPs, found in *Field Branches Quality System and Technical Procedures*: *Equipment Inventory and Management (SESDPROC-108-R3)*, April 2009; *Global Positioning System (SESDPROC-110-R2)*, November 2007; and *Field Sampling Quality Control (SESDPROC-011-R2)*. January 2008; all available at the following web address: http://www.epa.gov/region4/sesd/fbqstp/index.html. Laboratory data: Refer to the analytical methods listed in Section 5.0 and Appendix B, Table 3 of the SAP, dated November 16, 2009.
Representativeness	Sampling: Sample representativeness will be achieved by following the following guidance documents: EPA. 2007 through 2009. Region 4, SESD SOPs, found in *Field Branches Quality System and Technical Procedures*: *Global Positioning System (SESDPROC-110-R2)*, November 2007 *Ambient Air Sampling (SESDPROC-303-R1),* November 2007 *Soil Sampling (SESDPROC-300-R1)*, November 2007 *Waste Sampling (SESDPROC-302-R1)*, November 2007 *Bulk Sampling for Asbestos (SESDGUID-104-R0)*, August 2009 *Field Sampling Quality Control (SESDPROC-011-R2)*, January 2008 *Field Equipment Cleaning and Decontamination (SESDPROC-205-R1)*, November 2007 *Equipment Inventory and Management (SESDPROC-108-R3)*, April 2009. These documents can be found at the following web address: http://www.epa.gov/region4/sesd/fbqstp/index.html. EPA. 2008. Asbestos Committee of the Technical Review Workgroup of the Office of Solid Waste and Emergency Response (OSWER). *Framework for Investigating Asbestos-Contaminated Superfund Sites*. OSWER Directive #9200.0-68. September. EPA. 2007. ERT. *Activity-Based Air Sampling for Asbestos*. SOP No. 2084, Rev. No. 0.0. May 10.

Representativeness (continued)	EPA. 1994. ERT. *Asbestos Sampling.* SOP No. 2015, Rev. No. 0.0. November 17 American Society for Testing and Materials (ASTM). 1995. *D5755-95 Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Concentrations.* (Note: This is a historical standard that has been superseded. The most recent version is: ASTM International. 2003. *D5755-03 Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Surface Loading.* April 10.) EPA. 2004. Office of Research and Development. *Research Method for Sampling and Analysis of Fibrous Amphibole in Vermiculite Attic Insulation.* EPA/600/R-04/004. January. This method can be found at the following web address: http://www.epa.gov/nrmrl/pubs/600r04004/600r04004.pdf. Laboratory: Analytical representativeness will be achieved by following the analytical methods listed in Section 5.0 and Appendix B, Table 3 of the SAP dated November 16, 2009.
Completeness	Based on a review of the available file information, including previous sampling data, and discussions with the EPA OSC and ERT personnel, biased samples are proposed for collection to identify contaminant concentrations in and originating from onsite sources. Background samples will be collected to help evaluate whether potential background sources of asbestos are contributing to air quality in the vicinity of the site and whether a release from the site or activity has occurred. The EPA OSC is responsible for determining if the field and laboratory data collected during this project achieves the level of completeness required to meet the objectives of the project.
Comparability	Sample and data comparability is expected to be achieved through conducting all field and laboratory work using the same, well-documented, and uniform procedures.

TABLE 3: FIELD EQUIPMENT AND SUPPLIES

Site Name:	Vermiculite Exfo Palmetto GAO 148	**City, County:** Woodruff, Spartanburg County	**State:** South Carolina

Field Instruments	Sample Containers	Sampling Equipment and Supplies	Sample Processing Supplies	Decontamination Supplies	Miscellaneous Supplies
SKC Universal PCXR8 air pump or Gilian GilAir 5 air pump	25-mm-diameter, 0.8 µm mixed cellulose ester (MCE) filter cassette	Stainless steel spoons, bowls, and hand auger sets	Field data sheets	Plastic baby pool	Digital camera
SKC QuickTake 30 air pump	25-mm-diameter, 0.45 µm MCE filter cassette	Tyvek suits with booties and hoods	Custody seals	Pressurized liquid sprayers and compressed air	Permanent markers
Gilian Aircon 2 air pump	Resealable plastic baggies	Rubber boots or rubber over-boots	Laptop computer	55-gallon drums	Tables
Bios DryCal DC-Lite primary flow meter	Eight-ounce glass jars with Teflon-lined lids	Full-face powered air-purifying respirators with P-100 cartridges	Paper	Drum liners	Garbage bags
Rotameter with cassette adapter	Paper coin envelopes	Pin flags	Measuring tapes, bolt cutters, tool box	Paper towels	Gasoline storage can
Meteorological station		Nitrile or latex gloves	Sample labels	Chairs	Extension cords
Trimble GeoXT GPS unit		Visqueen or equivalent plastic sheeting	FedEx labels	Potable water supply and high-purity water supply	Power strips, 10-receptacle
Generator, portable		Electric leaf blowers	Strapping tape	5-Gallon buckets	First aid kit
All terrain vehicle		18- to 30-inch push brooms	Paper towels	Liquid detergent	Site fluids
Cassette tripod stands		20-inch diameter electric fans	Plastic baggies	Alcohol wipes	Coolers
Recreational vehicle		Backpacks	Chain-of-custody forms	Duct tape	Tent canopy
		Plastic tubing and clips	Logbooks	Scrub brushes	10-centimeter by 10-centimeter templates
		Leaf and garden rakes	Parafilm	Trash can	Zip-ties
		Bicycles	Clip boards	Ear plugs	Traffic cones

Notes:
µm Micrometer
mm Millimeter

APPENDIX D

SITE-SPECIFIC LEVEL 2 HEALTH AND SAFETY PLAN

(69 Pages)

TETRA TECH

Site Name: Vermiculite Exfo Palmetto GAO 148	**Site Contact: Randy P. Mayer**	**Telephone: 225-933-4534**
Location: 13101 HWY 221, Woodruff SC 29388	**Client Contact: Leonardo Ceron**	**Telephone: 678-936-1017**
EPA ID No. TTEMI-05-003-0078	**Prepared By: Randy P. Mayer**	**Date Prepared: 11/12/09**
Project No. 103DX90170003.0078	**Dates of Activities: Nov. 30 to Dec. 4, 2009** (HASP is not valid for periods longer than 12 months)	**Emergency Response** ☐ Yes ☒ No

Objectives:

Task 1: A sampling event to collect air samples for asbestos analysis to determine potential exposure risks to the occupants of the facility and the public. Samples will be collected while conducting activities that are reflective of actual and worst-case use scenarios for the facility. Two major types of sampling will occur: conducting outdoor activities likely to occur at the facility (for example, sweeping, raking, and similar activities) while collecting air samples, and, conducting aggressive-disturbance indoor air sampling involving strenuously disturbing the air within an enclosed space using leaf blowers and fans while collecting air samples. The work will require personnel to work in environments where particulates have been intentionally disturbed and caused to be suspended in the air. These particulates may contain asbestos.

Site Type: *Check as many as applicable.*

☒ Active	☐ Landfill	☐ Inner-City
☐ Inactive	☒ Railroad	☒ Rural
☐ Secured	☐ Residential	☐ Remote
☒ Unsecured	☒ Industrial	☐ Other (*specify*)

Project Scope of Work and Site Background

The site history and background presented below is based on a site visit conducted by EPA and START personnel on October 28, 2009, and through e-mail and telephone communication with the EPA On-Scene Coordinator (OSC). The GAO 148 site is located at 13101 Highway 221, Woodruff, Spartanburg County, South Carolina, 29388. The geographic coordinates for the site are latitude 34.6977 degrees north and longitude -81.9988 degrees west. The site consists of a large building, which includes: offices; and open air portions housing an exfoliation furnace, several large bays, and a cement mixing plant. Several piles of material are also located on the property. Some portions of the property are paved. The facility currently receives vermiculite concentrate from imported and local sources and expands the concentrate for packaging and shipment offsite. Some portions of the original property have been redeveloped including the construction of additional buildings. Sampling at the site has been conducted in the past, including on June 6, 2001. Based on information gathered regarding the GAO 148 site, EPA has concluded that further investigation is required at the site.

Health and Safety Plan Approver Signature: Chris Draper **Date:** APPROVED By Chris Draper at 1:25 pm, Nov 13, 2009

Note: A minimum of two persons with appropriate training and medical surveillance must be on site for any fieldwork subject to Level 2 HASP requirements.
Note: A detailed site sketch may be included on Page 10 of 12.

Waste Management Practices:

LIST HOW INVESTIGATION DERIVED WASTE (IDW) WILL BE MANAGED FROM THE SITE. FOR EXAMPLE, 'POTENTIAL AND SUSPECT ACBM WASTES GENERATED DURING BULK SAMPLING ACTIVITIES WILL BE TREATED AS ASBESTOS WASTE. ARRANGEMENTS WILL BE MADE WITH THE LABORATORY OR THE ASBESTOS ABATEMENT CONTRACTOR TO PROPERLY DISPOSE OF THE MATERIAL.

The air and bulk samples will be disposed of by the laboratory. Gloves and PPE will be placed in plastic bags or lined drums and stored on site. Decon water will be placed in drums and stored on site. Electric fans, leaf blowers, and other potentially reusable sampling equipment will be left at the site. Laboratory results for the collected samples will determine whether or not these items and materials have potentially been contaminated with asbestos. If asbestos contamination is not detected, the materials will be disposed locally (or retrieved in the case of fans, blowers, and other potentially reusable sampling equipment). If asbestos contamination is found, the materials will be properly disposed. No other IDW is expected to be generated.

Wind Speed and Direction (Approach from upwind)		Temperature (°F)	Relative Humidity (%)	Probability of Precipitation (%)	Weather Forecast (such as partly cloudy, snow, etc.)
Speed (mph):	From Direction:				

On-Site Supplies: ☒ First Aid Kit ☒ Fire Extinguisher ☐ Air Horn ☒ Thermometer ☐ Noise Dosimeter

Known or Anticipated Site Hazards or Concerns: (Hazards covered by existing Safe Work Practices are listed on the next page)

☒ Work on active roadway	☒ Overhead utilities	☒ Energized electrical systems
☐ Onsite laboratory	☐ Surface or underground storage tanks	☒ Portable hand tool use
☐ Explosion or fire hazard	☒ General slips, trips, falls	☒ Portable electrical tool use
☐ Oxygen deficiency	☒ Uneven, muddy, rugged terrain	☐ Machine guarding
☒ Inorganic chemicals	☒ Industrial truck (forklift) use	☒ Portable fire extinguisher use
☐ Organic chemicals	☐ Lift (man lift, cherry picker) use	☒ Driving commercial vehicles
☐ Chemical warfare materiel	☐ Scaffold use	☐ Driving personal vehicles
☐ Compressed Gas Cylinders	☒ Wood or metal ladder use	☐ Scientific diving operations
☒ Asbestos	☐ Dangerous goods shipped by air	☐ Injury and Illness Prevention Program (California only)
☒ Respirable particulates	☐ Elevated work (over 6' high)	☐ Ergonomics (California only)
☐ Respirable silica	☐ Construction work	☐ Client-specific safety requirements (attach to HASP)
☐ Blasting and explosives	☐ Excavation or trenching	☒ ATV use
☐ Non-ionizing radiation (lasers, radio frequencies, UV)	☐ Benching, shoring, bracing	☐ Methamphetamine lab
☒ High Noise	☐ Work in strip or shaft mines	☐ Mold
☐ Buried Utilities	☐ Grinding operations	☐ *Other (insert)*

Explosion or Fire Potential: ☐ High ☐ Medium ☒ Low ☒ Unknown

Chemical Products Tetra Tech EM Inc. Will Use or Store On Site: (Attach a Material Safety Data Sheet [MSDS] for each item.)

☒ Alconox or Liquinox	☐ Calibration gas (Methane)	☐ Hydrogen gas	☐ Isopropyl alcohol
☐ Hydrochloric acid (HCl)	☐ Calibration gas (Isobutylene)	☐ Household bleach (NaOCl)	☐ HazCat Kit
☐ Nitric acid (HNO_3)	☐ Calibration gas (Pentane)	☐ Sulfuric acid (H_2SO_4)	☐ Other__________
☐ Sodium hydroxide (NaOH)	☐ Calibration gas (4-gas mixture)	☐ Hexane	☒ Other eyewash solution

WARNING: Eyewash solution shall be readily available on ALL projects where corrosives (acids or bases) are used, including sample preservatives

Applicable Safe Work Practices (SWP) Attach to HASP: *Check as many as apply*

- ☒ SWP DCN 5-01 - General Safe Work Practices
- ☐ SWP 6-2 - Control of Hazardous Energy (Lockout-Tagout)
- ☐ SWP 6-3 - Work Near Drill Rigs
- ☐ SWP 6-4 - Excavation Work
- ☒ SWP DCN 5-06 - Working Over or Near Water
- ☐ SWP-6-6 - Hot Work
- ☒ SWP DCN 5-08 - Special Site Hazards (Bears, Firearms, Remote Areas, Mines, Abandoned Buildings, and Aircraft Hazards)
- ☐ SWP 6-8 - Electrical Work
- ☐ SWP 6-9 - Fall Protection
- ☒ SWP DCN 5-11 - Portable Ladder Safety
- ☐ SWP 6-11 - Drum and Container Handling
- ☐ SWP 6-12 - Shipping Dangerous Goods
- ☐ SWP 6-13 - Flammable Hazards and Ignition Sources
- ☐ SWP 6-14 - Accidental Spill and Discharge Controls
- ☒ SWP DCN 5-15 - Heat Stress
- ☒ SWP DCN 5-16 - Cold Stress
- ☒ SWP DCN 5-17 - Biohazards
- ☒ SWP DCN 5-19 - Safe Lifting Procedures
- ☐ SWP 6-21 - Sites with Ionizing Radiation Sources
- ☐ SWP 6-22 - Data Collection on Rivers
- ☐ SWP 6-23 - Permit-Required Confined Space
- ☐ SWP 6-24 - Non-Permit-Required Confined Space
- ☐ SWP 6-25 - Oil and other Petroleum Fuel Products
- ☒ SWP DCN 5-26 - Prevention of Sun Exposure
- ☒ SWP DCN 5-27 - Respirator Cleaning Practices
- ☒ SWP DCN 5-28 -Safe Use Practices for Use of Respirators
- ☒ SWP DCN 5-29 - Respirator Qualitative Fit Testing Procedures
- ☐ SWP 6-30 - Office Employees
- ☐ SWP 6-31 - Hurricane Affected Areas
- ☐ SWP 6-33 - UXO/MEC Field Work

Tasks Performed At Job Site that are NOT Covered by SWPs
NOTE: Many completed AHA's can be found on the Health & Safety intranet site

Attach Activity Hazard Analysis (AHA) for each non-covered task

- ☒ Aggressive-disturbance indoor air sampling
- ☒ Sweeping or raking of outdoor paved areas
- ☒ Walking and running in outdoor areas
- ☒ Bicycling
- ☒ ATV use

Tetra Tech Employee Training and Medical Requirements:

Basic Training and Medical

- ☒ Initial 40 Hour Training
- ☒ 8-Hour Supervisor Training (one-time)
- ☒ Current 8-Hour Refresher Training
- ☒ Current Medical Clearance (including respirator use)
- ☒ Current First Aid Training (minimum 1 Tetra Tech employee on site)
- ☒ Current CPR Training (minimum 1 Tetra Tech employee on site)
- ☒ Current Respirator Fit-Test

Other Specific Training and Medical Surveillance Requirements

- ☐ Confined Space Training
- ☐ Level A Training
- ☐ Radiation Training
- ☐ OSHA 10-hour Construction Safety
- ☐ Blood Lead Level and ZPP Pre and Post-Project
- ☐ Urinary Arsenic Level Pre and Post-Project
- ☒ Other: Asbestos Awareness
- ☒ Other: Asbestos Physical with B-Reader

Materials Present or Suspected at Site	Highest Observed Concentration (specify units and sample medium)	Exposure Limit (specify ppm or mg/m^3)	IDLH Level (specify ppm or mg/m^3)	Primary Hazards of the Material (explosive, flammable, corrosive, toxic, volatile, radioactive, biohazard, oxidizer, or other)	Symptoms and Effects of Acute Exposure	Photoionization Potential (eV)
Asbestos	Up to 100% of a suspect ACM	PEL/REL/TLV = 0.1 fibers per cubic cm; > 5 micrometers in length NOTE: 1.0 fiber per cubic cm for 30-minute excursion level	CARC	CARC	Asbestosis (chronic exposure), dyspnea, interstitial fibrosis, restricted pulmonary function, finger clubbing, irritated eyes, CARC	N/A
		PEL = REL = TLV = [Skin] Hazard ☐				
		PEL = REL = TLV = [Skin] Hazard ☐				
		PEL = REL = TLV = [Skin] Hazard ☐				
		PEL = REL = TLV = [Skin] Hazard ☐				
		PEL = REL = TLV = [Skin] Hazard ☐				

Specify Information Sources: NIOSH Pocket Guide to Hazardous Chemicals, September 2005 and American Conference of Governmental Industrial Hygienists (ACGIH). "Threshold Limit Values and Biological Exposure Indices for 2008."

Note: In the Exposure Limit column, include Ceiling (C) and Short-Term Exposure Limits (STEL) if they are available. Also, use the following short forms and abbreviations to complete the table above.

A = Air
ACM = Asbestos-containing material
CARC = Carcinogenic
cm = Centimeter
eV = Electron volt
U = Unknown
IDLH = Immediately dangerous to life or health
mg/m^3 = Milligram per cubic meter
NA = Not available
NE = None established
PEL = Permissible exposure limit
ppm = Part per million
REL = Recommended exposure limit
S = Soil
TLV = Threshold limit value

Note: If no contingency level of protection is selected, all employees covered under this plan must evacuate the immediate site area if air contaminant levels require upgrading PPE. This information is available on the chemical hazards page of this HASP.

Field Activities Covered Under this HASP:

Task Description	Level of Protection[1] Primary				Contingency				Date of Activities
	A	B	C	D	A	B	C	D	
1 General site inspection of hazards.	☐	☐	☐	☒	☐	☐	☐	☒	November 30, 2009
2 Conduct aggressive-disturbance indoor air sampling inside of structures at the facility. Air samples for asbestos analysis will be collected using pumps of both high flow rate (10 liters per minute) and low flow rate (3 liters per minute). Solid (bulk material and dust) samples may also be collected.	☐	☐	☒	☐	☐	☐	☒	☐	November 30 through December 4, 2009
3 Conduct activity–based outdoor air sampling by sweeping paved areas; raking unpaved areas; and running, walking, bicycling, or ATV-riding in specified areas; all under dry atmospheric conditions. Air samples for asbestos analysis will be collected using pumps of both high flow rate (10 liters per minute) and low flow rate (3 liters per minute). Solid (bulk material and dust) samples may also be collected.	☐	☐	☒	☐	☐	☐	☒	☐	November 30 through December 4, 2009
4	☐	☐	☐	☐	☐	☐	☐	☐	
5	☐	☐	☐	☐	☐	☐	☐	☐	

Site Personnel and Responsibilities (include subcontractors):

Employee Name and Office Code / Location	Task(s)	Responsibilities
John Schendel, Duluth, GA	Task 1, 2, 3	• Project Manager: Manages the overall project, makes site safety coordinator (SSC) aware of pertinent project developments and plans, and maintains communications with client as necessary. Additionally, for projects lasting longer than one consecutive week on-site, the Project Manager is responsible for conducting one field audit using Form AF-1.
Randy Mayer, Duluth, GA	Field Team Leader and SSC; Task 1, 2, 3	• Field Team Leader: Directs field activities, makes site safety coordinator (SSC) aware of pertinent project developments and plans, and maintains communications with the Project Manager and the client as necessary
Randy Mayer, Duluth, GA	Field Team Leader and SSC; Task 1, 2, 3	• Site Safety Coordinator (SSC): Ensures that appropriate personal protective equipment (PPE) is available, enforces proper use of PPE by on-site personnel and subcontractors; suspends investigative work if personnel are or may be exposed to an immediate health hazard; implements and enforces the HASP; identifies and controls site hazards when possible; communicates site hazards to all personnel; and reports any deviations observed from anticipated conditions described in the health and safety plan to the health and safety representative. • Alternate Site Safety Coordinator (if any)
James Ferreira, Cincinnati, OH; Vicky Farmer, Cincinnati, OH; Debbie Kristiansen, Duluth, GA; and Spencer Smith, Baton Rouge, LA	Field Personnel, Task 2, 3	• Field Personnel: Completes tasks as directed by the project manager, field team leader, and SSC, and follows the HASP and all SWPs and guidelines established in the Tetra Tech, Inc., Health and Safety Manual.

Note:
1. See next page for details on levels of protection

NOTE: Contingency level of protection section should be completed only if the upgraded level of protection is immediately available at the job site. If no contingency level of protection is denoted, all employees covered under this HASP must evacuate the immediate site area if air contaminant levels would require an upgrade of PPE.

Protective Equipment: (Indicate type or material as necessary for each task.)

Task	Primary Level of Protection (A,B,C,D)	PPE Component Description (Primary)	Contingency Level of Protection (A, B, C, D)	PPE Component Description (Contingency)
1	D	Respirator type: Not needed Cartridge type (if applicable): CPC material: Not needed Glove material(s): Nitrile, Surgical Boot material: Steel-toe, Steel-shank Other: Safety Glasses, Hard Hat, First Aid Kit, Overboots or rubber boots, Portable Eyewash, Ear Plugs as needed	D	Respirator type: Not needed Cartridge type (if applicable): CPC material: Not needed Glove material(s): Nitrile, Surgical Boot material: Steel-toe, Steel-shank Other: Safety Glasses, Hard Hat, First Aid Kit, Overboots or rubber boots, Portable Eyewash, Ear Plugs as needed
2	C	Respirator type: Full-face PAPR Cartridge type (if applicable): P-100 (HEPA) CPC material: TYVEK coveralls with hood and booties; also rubber boots or overboots in some circumstances where risk of wearing through TYVEK booties is suspected Glove material(s): Nitrile, Surgical; work gloves as necessary Boot material: Steel-Toe/Steel-Shank Other: Hard Hat, Hearing protection for high-noise activities (use of fans, leaf blowers, weed–wackers, and ATVs), First Aid Kit, Portable Eyewash	C	Respirator type: Full-face PAPR Cartridge type (if applicable): P-100 (HEPA) CPC material: TYVEK coveralls with hood and booties; also rubber boots or overboots in some circumstances where risk of wearing through TYVEK booties is suspected Glove material(s): Nitrile, Surgical; work gloves as necessary Boot material: Steel-Toe/Steel-Shank Other: Hard Hat, Hearing protection for high-noise activities (use of fans, leaf blowers, weed–wackers, and ATVs), First Aid Kit, Portable Eyewash
3	C	Respirator type: Full-face PAPR Cartridge type (if applicable): P-100 (HEPA) CPC material: TYVEK coveralls with hood and booties; also rubber boots or overboots in some circumstances where risk of wearing through TYVEK booties is suspected Glove material(s): Nitrile, Surgical; work gloves as necessary Boot material: Steel-Toe/Steel-Shank Other: Hard Hat, Hearing protection for high-noise activities (use of fans, leaf blowers, weed–wackers, and ATVs), First Aid Kit, Portable Eyewash	C	Respirator type: Full-face PAPR Cartridge type (if applicable): P-100 (HEPA) CPC material: TYVEK coveralls with hood and booties; also rubber boots or overboots in some circumstances where risk of wearing through TYVEK booties is suspected Glove material(s): Nitrile, Surgical; work gloves as necessary Boot material: Steel-Toe/Steel-Shank Other: Hard Hat, Hearing protection for high-noise activities (use of fans, leaf blowers, weed–wackers, and ATVs), First Aid Kit, Portable Eyewash
4		Respirator type: Cartridge type (if applicable): CPC material: Glove material(s): Boot material: Other:		Respirator type: Cartridge type (if applicable): CPC material: Glove material(s): Boot material: Other:
5		Respirator type: Cartridge type (if applicable): CPC material: Glove material(s): Boot material: Other:		Respirator type: Cartridge type (if applicable): CPC material: Glove material(s): Boot material: Other:

Respirator Notes:
Respirator cartridges may only be used for a maximum time period of 8 hours or one work shift, whichever is less, and must be discarded at that time. For job sites with organic vapors, respirator cartridges may be used as described in this note as long as the concentration is less than 200 parts per million (ppm), the boiling point is greater than 70 °Celsius, and the relative humidity is less than 85 percent. If any of these levels are exceeded, a site-specific respirator cartridge change-out schedule must be developed and included in the HASP using Tetra Tech Form RP-2 (Respiratory Hazard Assessment Form)

Notes:
All levels of protection must include eye, head, and foot protection.
CPC = Chemical protective clothing
Thermoluminescent Dosimeter (TLD) Badges must be worn during all field activities on sites with radiation hazards. TLDs must be worn under CPC.

Monitoring Equipment: All monitoring equipment on site must be calibrated before and after each use and results recorded in the site logbook				
Instrument (Check all required)	**Task**	**Instrument Reading**	**Action Guideline**	**Comments**
☐ Combustible gas indicator model:	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	0 to 10% LEL	Monitor; evacuate if confined space	
		10 to 25% LEL	Potential explosion hazard; notify SSC	
		>25% LEL	Explosion hazard; interrupt task; evacuate site; notify SSC	
☐ Oxygen meter model:	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	>23.5% Oxygen	Potential fire hazard; evacuate site	
		23.5 to 19.5% Oxygen	Oxygen level normal	
		<19.5% Oxygen	Oxygen deficiency; interrupt task; evacuate site; notify SSC	
☐ Radiation survey meter model:	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	Normal background	Proceed	Annual exposure not to exceed 1,250 mrem per quarter Background reading must be taken in an area known to be free of radiation sources.
		Two to three times background	Notify SSC	
		>Three times background	Radiological hazard; interrupt task; evacuate site; notify Health Physicist	
☐ Photoionization detector model: ☐ 11.7 eV ☐ 10.6 eV ☐ 10.2 eV ☐ 9.8 eV ☐ ________ eV	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	Any response above background to 5 ppm above background	Level C[a] is acceptable Level B is recommended	These action levels are for unknown gases or vapors. After the contaminants are identified, action levels should be based on the specific contaminants involved.
		> 5 to 500 ppm above background	Level B	
		> 500 ppm above background	Level A	
☐ Flame ionization detector model:	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	Any response above background to 5 ppm above background	Level C[a] is acceptable Level B is recommended	These action levels are for unknown gases or vapors. After the contaminants are identified, action levels should be based on the specific contaminants involved.
		>5 to 500 ppm above background	Level B	
		>500 above background	Level A	
☐ Detector tube models:	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	Specify: < 1/2 the PEL > 1/2 the PEL	Specify:	The action level for upgrading the level of protection is one-half of the contaminant's PEL. If the PEL is reached, evacuate the site and notify a safety specialist
☐ Other (specify):	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	Specify:	Specify:	

Notes:
eV= electron volt LEL=Lower explosive limit mrem=Millirem PEL=Permissible exposure limit ppm=Part per million
a. Level C may be acceptable for certain tasks in some situations. If you are uncertain whether Level C is appropriate, consult the Regional Safety Officer. Additionally, when working with unknown respiratory hazards, Level C cartridge must provide protection for organic vapors, acid gases, ammonia, amines, formaldehyde, hydrogen fluoride, and particulate aerosols.

Project-Specific Industrial Hygiene Requirements

OSHA-Regulated Chemicals:

Check any present on the job site in any medium (air, water, soil)

- [ ] No chemicals below are located on the job site
- [x] Friable Asbestos
- [ ] alpha-Napthylamine
- [ ] Methyl chloromethyl ether
- [ ] 3,3'-Dichlorobenzidine (and its salts)
- [ ] bis-Chloromethyl ether
- [ ] beta-Napthylamine
- [ ] Benzidine
- [ ] 4-Aminodiphenyl
- [ ] Ethyleneimine
- [ ] beta-Propiolactone
- [ ] 2-Acetylaminoflourene
- [ ] 4-Dimethylaminoazobenzene
- [ ] N-nitrosomethylamine
- [ ] Vinyl chloride
- [ ] Inorganic arsenic
- [ ] Lead
- [ ] Chromium (VI)
- [ ] Cadmium
- [ ] Benzene
- [ ] Coke oven emissions
- [ ] 1,2-Dibromo-3-chloropropane
- [ ] Acrylonitrile
- [ ] Ethylene oxide
- [ ] Formaldehyde
- [ ] Methylenedianiline
- [ ] 1,3-Butadiene
- [ ] Methylene chloride

Emergency Contacts:

Emergency Contacts:	Telephone No.
Work Care and Incident Intervention	(800) 455-6155
Tetra Tech EMI 24-hour Anonymous Hazard Reporting Line	(866) 383-8070
U.S. Coast Guard National Response Center	(800) 424-8802
InfoTrac	(800) 535-5053
Fire department	911
Police department	911

Personnel Call-Down List:

Job Title or Position:	Name	Primary Phone:
Regional Safety Officer	Chris Draper	615-969-1334
Office Health and Safety Coordinator:	Wendy Robinson	678-775-3082
Task Order Manager:	Sandra Harrigan	678-775-3088
Field Team Leader:	Randy Mayer	225-933-4534
Site Safety Coordinator (SSC):	Randy Mayer	225-933-4534
Subcontractor SSC:		

Medical and Site Emergencies:

Signal a site or medical emergency with three blasts of a loud horn (car horn, fog horn, or similar device). Site personnel should evacuate to the area of safe refuge designated on the site map.

Hospital Name: Laurens County Health Care System
Address: 22725 Highway 76
Clinton, SC 29325-7527

General Phone: 864-833-9100
Emergency Phone: 911
Ambulance Phone: 911

Hospital called to verify emergency services are offered? YES ☒ NO ☐

Step-by-step Route to Hospital: (see Page 11 of 12 for route map)

Note: This page must be posted on site.

Decontamination Procedures

The site safety coordinator overseas implementation of project decontamination procedures and is responsible for ensuring they are effective.

Personnel Decontamination

Level D Decon - ☒ Wet ☒ Dry

Level C Decon - ☒ Wet ☐ Dry

Level B Decon – Briefly outline the level B decontamination methods to be used on a separate page attached to this HASP.

Level A Decon – A Level 3 HASP is required. Notify your regional health and safety representative and health and safety director.

Equipment Decontamination

All tools, equipment, and machinery from the Exclusion Zone (hot) or Contamination Reduction Zone (warm) are decontaminated in the CRZ before they are removed to the Support Zone (cold). Equipment decontamination procedures are designed to minimize the potential for hazardous skin or inhalation exposure, cross-contamination, and chemical incompatibilities.

Respirator Decontamination

Respirators are decontaminated in compliance with SWP 6-27 and should be included with this HASP.

Waste Handling for Decontamination

Procedures for decontamination waste disposal meet all applicable local, state, and federal regulations.

Decontamination Equipment

- ☐ Washtubs
- ☒ Buckets
- ☒ Scrub brushes
- ☒ Pressurized sprayer
- ☒ Detergent [Liquinox]
- ☐ Solvent [Type]
- ☐ Household bleach solution
  Concentration/Dilution: ____________
- ☐ Deionized water
- ☒ Disposable sanitizer wipes
- ☐ Facemask sanitizer powder
- ☐ Wire brush
- ☒ Spray bottle
- ☒ Tubs / pools
- ☒ Banner/barrier tape
- ☒ Plastic sheeting
- ☐ Tarps and poles
- ☒ Trash bags
- ☒ Trash cans
- ☒ Duct tape
- ☒ Paper towels
- ☒ Folding chairs
- ☐ Other

Emergency Response Planning

During the pre-work briefing and daily tailgate safety meetings, all on-site employees will be trained in the provisions of emergency response planning, site communication systems, and site evacuation routes.

In the event of an emergency that necessitates evacuation of a work task area or the site, the following procedures will take place.

- The Tetra Tech SSC will contact all nearby personnel using the on-site communications to advise the personnel of the emergency.
- The personnel will proceed along site roads to a safe distance upwind from the hazard source.
- The personnel will remain in that area until the SSC or an authorized individual provides further instructions.

In the event of a severe spill or a leak, site personnel will follow the procedures listed below.

- Evacuate the affected area and relocate personnel to an upwind location.
- Inform the Tetra Tech SSC, a Tetra Tech office, and a site representative immediately.
- Locate the source of the spill or leak, and stop the flow if it is safe to do so.
- Begin containment and recovery of spilled or leaked materials.
- Notify appropriate local, state, and federal agencies.

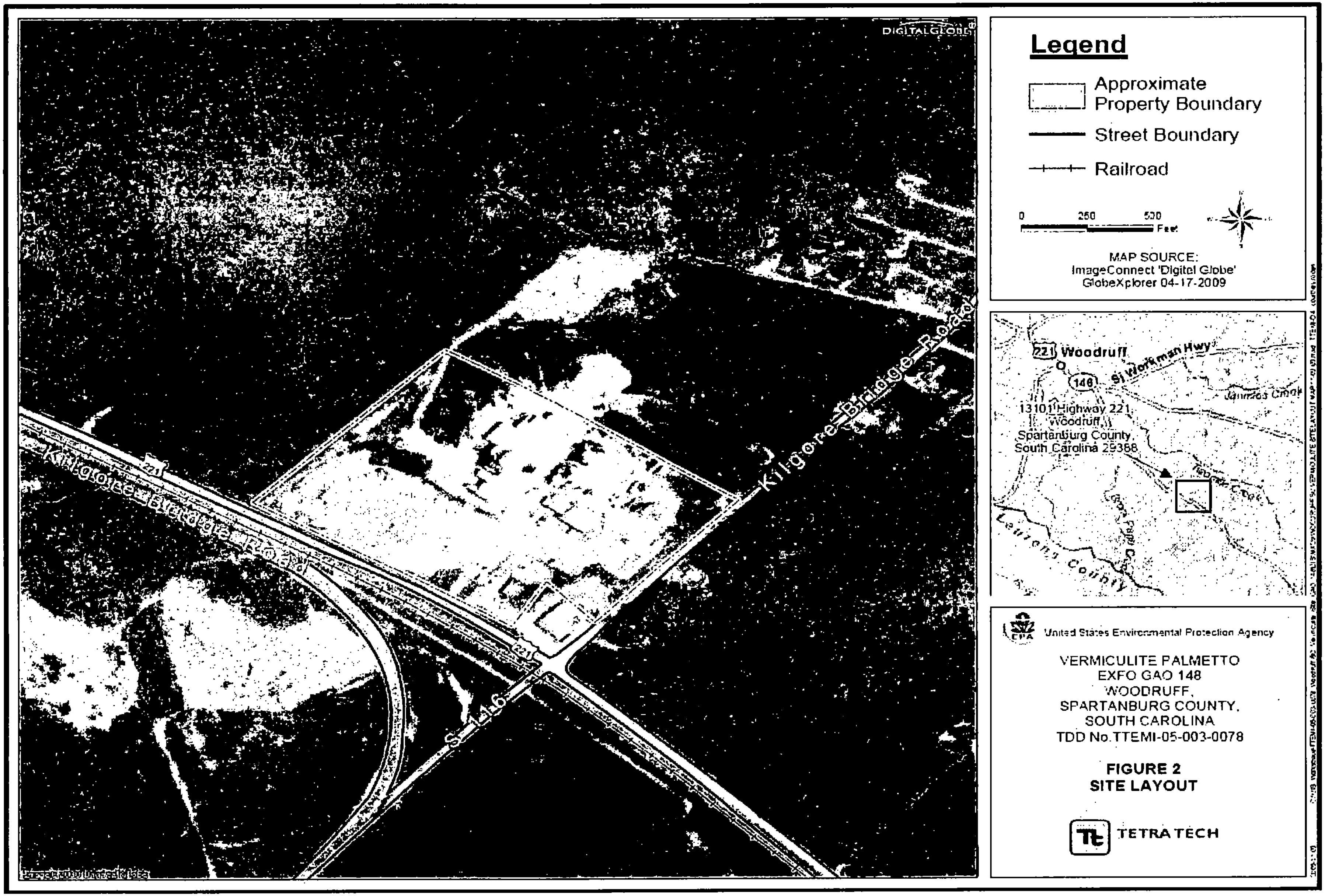
In the event of severe weather, site personnel will follow the procedures listed below.

- Site work shall not be conducted during severe weather, including high winds and lightning.
- In the event of severe weather, stop work, lower any equipment (drill rigs) and evacuate the affected area.
- Severe weather may cause heat or cold stress. Refer to SWPs 15 and 16 for information on both.

All work-related incidents must be reported. According to TtEMI's reporting procedures, for non-emergency incidents you should:

- Notify WorkCare and Incident Intervention at (800) 455-6155
- Notify your Project Manager or Regional Safety Officer (RSO) via phone.
- Complete a "Tetra Tech Incident Report" (Form IR) within 24 hours and send it to your RSO. If an injury or illness has occurred, the Form IR-A and the WorkCare HIPAA form must be completed at the same time the Form IR is completed.

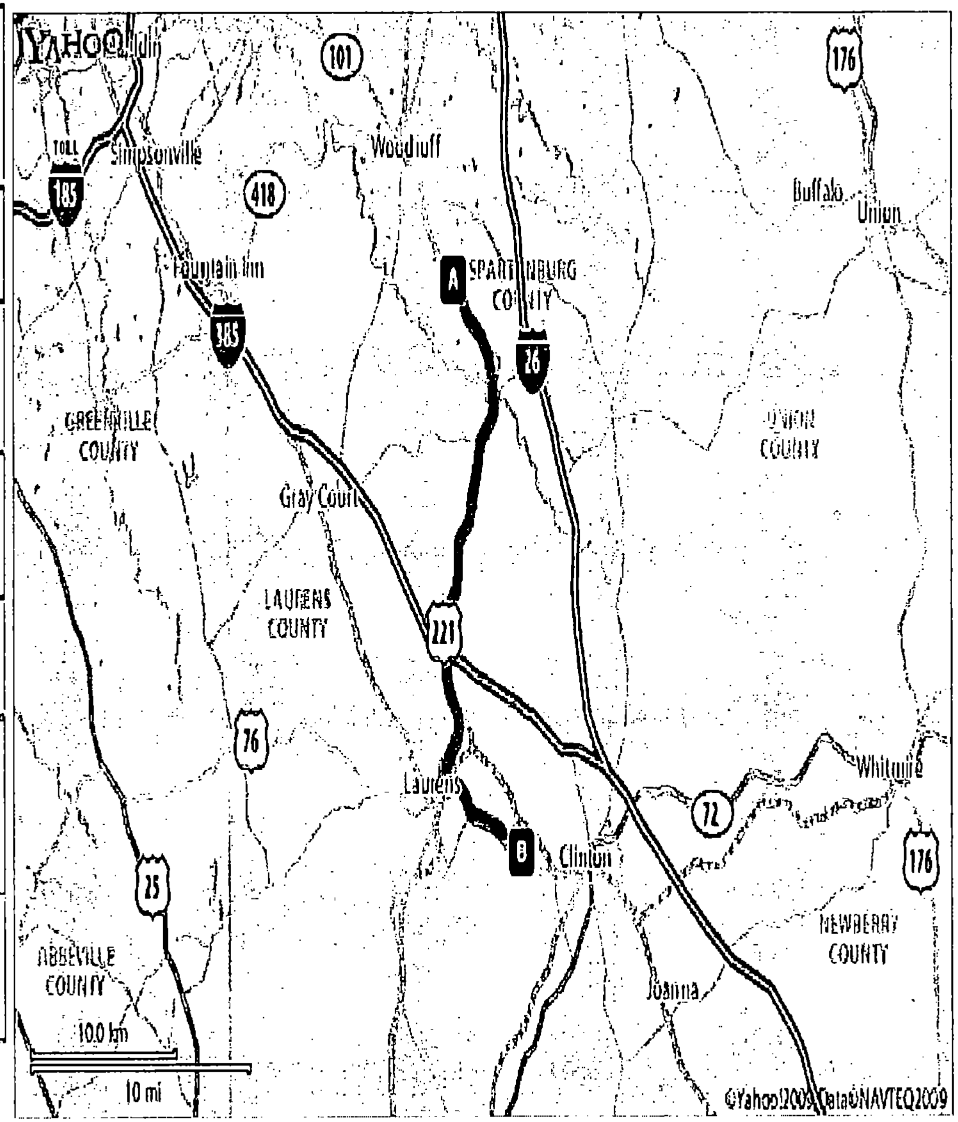
Site Map (See also the sampling plan):



Hospital Route Map (attach or insert):

A	1. Start at 13101 HIGHWAY 221, WOODRUFF going toward KILGORE BRIDGE RD	go 3.71 mi
	2. Continue on US-221	go 11.41 mi
	3. Turn L on US-76-BYP	go 1.77 mi
	4. Turn L on E MAIN ST(US-76-BR)	go 75 ft
	5. Continue on US-76	go 2.76 mi
	6. Make a U-Turn at CORNWELL RD onto HIGHWAY 76 E (US-76 W)	go 0.29 mi
B	7. Arrive at 22725 US-76, CLINTON, on the R	

Time: 32 mins, Distance: 19.97 mi



Note: A dry-run should be conducted to establish a physical location associated with the map included in the HASP. Verbal verification from the hospital emergency room should also be obtained to ensure that the hospital will accept chemically contaminated patients.

APPROVAL AND SIGN-OFF FORM

Project No.: 103DX90170003.0078

I have read, understood, and agree with the information set forth in this Health and Safety Plan and will follow the direction of the Site Safety Coordinator (SSC) as well as procedures and guidelines established in the Tetra Tech, Inc., Health and Safety Manual. I understand the training and medical requirements for conducting field work and have met these requirements.

Name	Company / Agency / Organization	Signature	Date

I have read, understood, and agree with the information set forth in this Health and Safety Plan and comply with and will enforce this HASP, as well as procedures and guidelines established in the Tetra Tech, Inc., Health and Safety Manual.

Name	Project-Specific Position	Signature	Date
John Schendel	Project Manager		
Randy Mayer	Site Safety Coordinator		
	Subcontractor SSC		

Tetra Tech has prepared this plan solely for the purpose of the health and safety protection of Tetra Tech employees. Subcontractors, visitors, and others at the site, while required to read and follow the provisions outlined in this plan at a minimum, should refer to their safety program for specific information related to their health and safety protection.

Note: Use Additional sheets as necessary to ensure that all personnel sign and affirm this document.

TETRA TECH

Safety Excellence

VOLUNTARY PROTECTION PROGRAM

VPP

Voluntary Protection Programs
An OSHA Cooperative Program

Management Leadership

Lead by example. Good managers recognize the benefits of a strong safety program and ensure that their personnel and subcontractors have the right tools, equipment, and attitude to work safely.

Some areas where effective management leadership for safety can be demonstrated include:

- Provide visible safety leadership - start meetings with a safety topic, integrate safety into planning, scheduling, and budgeting processes, take personal action to resolve safety issues.
- Become involved in incident reporting, investigation, corrective action - share lessons learned.
- Include subcontractors in your safety program and oversee their work.

Employee Involvement

Get involved! Take personal action and work directly with your supervisor daily to identify, control, or eliminate potential safety hazards.

Other ways to become involved in the safety program and improve work conditions include:

- Initiate hazard reports to identify hazards, suggest improvements, and recognize safe behaviors
- Participate in safety meetings and worksite safety inspections (daily, weekly, monthly, and quarterly)
- Participate in incident reports, investigations, corrective actions, and Lessons Learned

Worksite Analysis

The process of identifying and evaluating potential hazards is a critical element in achieving zero incidents and creating low risk and hazard-free work areas.

Worksite analysis methods used to identify and evaluate potential hazards include:

- Safety inspections (daily, weekly, monthly, and quarterly)
- Develop or review safe work procedures, AHA's, and the HASP
- Monitoring for air quality, heat stress, noise, ergonomics and other job hazards

Hazard Prevention and Control

Eliminating hazards from your job, preventing new hazards, and controlling known hazards are fundamental parts of the projects safety program.

Important points include:

- Control hazards by:
  - Installing and maintaining ***Engineering Controls***
  - Following ***Administrative/Work Practice Controls*** (HASP, AHAs, and safe work practices)
  - Specifying and wearing ***Personal Protective Equipment*** where needed
- Perform integrated safety reviews for new or modified work tasks
- Consult with qualified medical and safety professionals as needed

Safety and Health Training

Effective safety training is an important element in incident prevention. Remember, if you are unfamiliar with the work or feel that you don't have the necessary training, speak up and notify your team leader or project manager.

Safety training methods that may be used at the project include:

- New employee orientation, including HASP and task-specific training
- Project meetings, daily briefings, and/or task briefings
- Lessons learned and monthly safety communications

DEFINITIONS AND NOTES

Emergency Contacts

Work Care - For issues requiring an Occupational Health Physician; assistance is available 24 hours per day, 7 days per week.

InfoTrac — For issues related to incidents involving the transportation of hazardous chemicals; this hotline provides accident assistance 24 hours per day, 7 days per week

U.S. Coast Guard National Response Center — For issues related to spill containment, cleanup, and damage assessment; this hotline will direct spill information to the appropriate state or region

Limitations:

The Level-Two HASP is not appropriate in some cases:

- **Projects involving unexploded ordnance (UXO), radiation sources as the primary hazard, or known chemical/biological weapons site must employ the Level 3 HASP**
- **Projects of duration longer than 1 month must employ the Level 3 HASP**
- **Projects with more than five tasks must employ the Level 3 HASP**

Decontamination:

Decontamination Solutions for Chemical and Biological Warfare Agents[a]: PPE and equipment can be decontaminated using 0.5 percent bleach (1 gallon laundry bleach to 9 gallons water) for biological agents (15 minutes of contact time for anthrax spores; 3 minutes for others) followed by water rinse for chemical and biological agents. In the absence of bleach, dry powders such as soap detergents, earth, and flour can be used. The powders should be applied and then wiped off using wet tissue paper. Finally, water and water/soap solutions can be used to physically remove or dilute chemical and biological agents. Do not use bleach solution on bare skin; use soap and water instead. Protect decontamination workers from exposure to bleach.

Decontamination for Radiological and Other Chemicals: Primary decontamination should use Alconox and water unless otherwise specified in chemical specific information resources. The effectiveness of radiation decontamination should be checked using a radiation survey instrument. Decontamination procedures should be repeated until the radiation meter reads less than 100 counts per minute over a 100-square-centimeter area when the probe is held 1 centimeter from the surface and moving slower than 2.5 centimeters per second.

Decontamination Corridor: The decontamination setup can be adjusted to meet the needs of the situation. The decontamination procedures can be altered to meet the needs of the specific situation when compound- and site-specific information is available.

Decontamination Waste: All disposable equipment, clothing, and decontamination solutions will be double-bagged or containerized in an acceptable manner and disposed of with investigation-derived waste.

Decontamination Personnel: Decontamination personnel should dress in the same level of PPE or one level below the entry team PPE level.

All investigation-derived waste should be left on site with the permission of the property owner and the EPA on-scene coordinator. In some instances, another contractor will dispose of decontamination waste and investigation-derived waste. DO NOT place waste in regular trash. DO NOT dispose of waste until proper procedures are established.

Notes:

[a] Source: Jane's Information Group. 2002. *Jane's Chem-Bio Handbook.* Page 39.

TETRA TECH, INC.

DAILY TAILGATE SAFETY MEETING FORM

Date: ______________ Time: ________________ Project No.: ________________

Client: ____________________________________ Site Location: __________________________

Site Activities Planned for Today: ____

Weather Conditions: ____

Safety Topics Discussed	
Protective clothing and equipment:	
Chemical and physical hazards:	
Emergency procedures:	
Equipment hazards:	
Other:	
Attendees	
Printed Name	**Signature**

Meeting Conducted by:

____ ____

Name Signature

10/08

TETRA TECH EM INC.

HEALTH AND SAFETY PLAN AMENDMENT

Site Name: ____

Amendment Date: ____

Purpose or Reason for Amendment: ____

____

____

Required Additional Safe Work Practices or Activity Hazard Analyses: ______________________

____

Required Changes in PPE: ____

____

____

____

Action Level Changes: ____

____

____

____

____

AMENDMENT APPROVAL

RSO or Designee	Name	Signature	Date
Site Safety Coordinator	Name	Signature	Date

Date presented during daily site safety meeting: ____

10/08

TETRA TECH, INC.

FIELD AUDIT CHECKLIST

Project Name: ______________________ Project No.: ______________________

Field Location: ______________________ Completed by: ______________________

Project Manager: ______________________ Site Safety Coordinator: ______________________

General Items		In Compliance?		
Health and Safety Plan Requirements		Yes	No	NA
1	Approved health and safety plan (HASP) on site or available			
2	Names of on-site personnel recorded in field logbook or daily log			
3	HASP compliance agreement form signed by all on-site personnel			
4	Material Safety Data Sheets on site or available			
5	Designated site safety coordinator physically present on jobsite			
6	Daily tailgate safety meetings conducted and documented on Form HST-2			
7	Documentation available proving compliance with HASP requirements for medical examinations, fit testing, and training (including subcontractors)			
8	HASP onsite matches scope of work being conducted			
9	Emergency evacuation plan in place and hospital located			
10	Exclusion, decontamination, and support zones delineated and enforced			
11	HASP attachments present onsite (VPP sheet, audit checklist, AHA, etc.)			
12	Illness and injury prevention program reports completed (California only)			
Emergency Planning				
13	Emergency telephone numbers posted			
14	Emergency route to hospital posted			
15	Local emergency providers notified of site activities			
16	Adequate safety equipment inventory available			
17	First aid provider and supplies available			
18	Eyewash solution available when corrosive chemicals are present			
Air Monitoring				
19	Monitoring equipment specified in HASP available and in working order			
20	Monitoring equipment calibrated and calibration records available			
21	Personnel know how to operate monitoring equipment and equipment manuals available on site			
22	Environmental and personnel monitoring performed as specified in HASP			

Safety Items		In Compliance?		
Personal Protection		Yes	No	NA
23	Splash suit, if required			
24	Chemical protective clothing, if required			
25	Safety glasses or goggles (always required)			
26	Gloves, if required			
27	Overboots, if required			
28	Hard hat (always required)			
29	High visibility vest, if required			
30	Hearing protection, if required			
31	Full-face respirator, if required			
Instrumentation				
32	Combustible gas meter and calibration notes			
33	Oxygen meter and calibration notes			
34	Organic vapor analyzer and calibration notes			
Supplies				
35	Decontamination equipment and supplies			
35	Fire extinguishers			
37	Spill cleanup supplies			
Corrective Action Taken During Audit:				

Note: NA = Not applicable

Auditor's Signature

Site Safety Coordinator's Signature

Date

Tetra Tech, Inc.	ACTIVITY HAZARD ANALYSIS (AHA) Tetra Tech EM Inc. **(Insert Task Name Here)**	
Task Description		
This Activity Hazard Analysis (AHA) applies to the task listed above. It has been developed and approved by the Director of Health and Safety for Tetra Tech EMI. The AHA contains potential hazards posed by each major step in this task, lists procedures to control hazards, and presents required equipment (including safety equipment), inspections, and training. The hazard controls listed below are specific to this task.		
Hazards		**Actions**
Task Steps	**Potential Hazards**	**Critical Safety Procedures and Controls**
Equipment to be Used	**Inspection Requirements**	**Training Requirements**

Assessed By __________ Name __________ Signature __________ Date

Approved By __________ Name __________ Signature __________ Date

To prevent injuries and adverse health effects, the following general safe work practices (SWP) are to be followed when conducting work involving known and unknown site hazards. These SWPs establish a pattern of general precautions and measures for reducing risks associated with field operations not conducted on hazardous waste sites. This list is not inclusive and may be amended as necessary.

- Be familiar with and knowledgeable of and adhere to all instructions in the construction health and safety plan (C-HASP), job safety analysis, job hazard analysis, work permit or other health and safety documentation.
- At a minimum, a safety meeting will be held at the start of each project to discuss the hazards of the site and site work. Additional meetings will be held, as necessary, to address new or continuing safety and health concerns.
- Be aware of the location of the nearest telephone and all emergency telephone numbers.
- Attend a briefing on the anticipated hazards, equipment requirements, SWPs, emergency procedures, and communication methods before going on site.
- Plan and delineate entrance, exit, and emergency escape routes.
- Rehearse unfamiliar operations prior to implementation.
- Use the "buddy system" whenever respiratory protection, fall protection, or other protective equipment is in use. Buddies should establish hand signals or other means of emergency communication in case radios break down or are unavailable.
- In order to assist each other in the event of an emergency, buddies should maintain visual contact with each other and with other on-site team members by remaining in close proximity.
- Do not bring nonessential vehicles and equipment onto the site.
- Immediately report all injuries, illnesses, and unsafe conditions, practices, and equipment to the site safety coordinator (SSC).
- Maintain a portion of the site field logbook as a project safety log. The project safety log will be used to record the names, entry and exit dates, and times on site of all Tetra Tech personnel, subcontractor personnel, and project site visitors; and other information related to safety matters.

- A portable eyewash station should be located in the support zone if corrosive materials are used or stored on the site.
- Smoking is not allowed on Tetra Tech projects sites, except in designated smoking areas.
- Do not bring matches and lighters in the exclusion zone or contamination reduction zone.
- Observe coworkers for signs of toxic exposure and heat or cold stress.
- Inform coworkers of nonvisual effects of illness if you experience them, such as headaches, dizziness, nausea, or blurred vision.
- Anyone known to be under the influence of drugs or intoxicating substances that impair the employee's ability to safely perform assigned duties shall not be allowed on the job while in that condition.
- Horseplay, scuffling, and other acts that tend to have an adverse influence on the safety or well-being of the employees is prohibited.
- Work shall be well planned to prevent injuries in the handling of materials and when working with equipment.
- No one shall knowingly be permitted or required to work while the employee's ability or alertness is so impaired by fatigue, illness, or other causes that might unnecessarily expose the employee or others to injury.
- Use proper lifting techniques. Heavy objects will be lifted using the large muscles of the leg instead of the smaller muscles of the back.
- Wear appropriate footwear and all other protective equipment required for work.
- Cleanse thoroughly after handling hazardous substances.
- Maintain all tools and equipment in good condition.
- First aid kits shall be located in a prominent location and stocked with basic first aid supplies.

Revision Date	Document Authorizer		Revision Details
	Name	Approval Date	
10/1/2008	Chris McClain		NEW
	Rick Lemmon		

The following sections discuss general procedures for working over or near water, underwater work, and cold water procedures.

1.0 SCOPE

This safe work practice (SWP) provides guidelines for all Tetra Tech employees and subcontractors who work over or near bodies of water three (3) or more feet deep or swiftly moving water. This SWP was developed in accordance with the Occupational Safety and Health Administration (OSHA) standard specified in Title 29 of the *Code of Federal Regulations* (CFR), Part 1926.106, "Working Over or Near Water."

2.0 RESPONSIBILITIES

The project manager (PM) is responsible for identifying all health and safety requirements of each project, including all tasks that may involve worker exposure to hazards or working in or near bodies of water. The PM will appoint a site safety coordinator (SSC) to ensure that this SWP is followed in the field. Workers will follow this SWP whenever working near or in any body of water that is over three (3) feet deep or swiftly moving.

3.0 GENERAL PROCEDURES

When working over or near water, the following precautions will be taken:

- All staff and team members must wear a personal flotation device (PFD) when working within 15 feet of a water body. Personnel will be provided with U.S. Coast Guard (USCG)-approved life jackets or work vests. The PFD should be Class III, which will support the head of an unconscious person above water.
- Life jackets and work vests will be inspected before and after each use.
- Ring buoys with at least 90 feet of line shall be provided and readily available for employee rescue operations.
- The distance between ring buoys shall not exceed 200 feet.

- A USCG-approved life-saving skiff will be available.
- Under no circumstances will team members enter water bodies without protective clothing such as rubber boots or waders.
- At least one person will remain on shore as a look-out.

If a team member falls into the water, a ring buoy, branch, paddle, pole, or other floating object should be extended to the person in the water. Resist the impulse to dive in; employees should not attempt a deep water rescue unless they have been trained in water lifesaving skills. When the person in the water grabs the extended item, the worker should be pulled toward the shore or boat. If the person is unconscious, the PFD, clothing, or hair should be hooked to pull the person toward the shore or boat. Once the person has been safely retrieved, necessary emergency medical procedures should be performed by qualified personnel. If none are necessary, the retrieved team member should change into dry clothing as soon as possible after any necessary personal decontamination.

4.0 UNDERWATER WORK

Underwater work should be performed in accordance with the procedures and guidelines of the Diving Safety Program (Document Control No. 2-15).

5.0 COLD WATER PROCEDURES

When the water temperature is below 45 °F, hypothermia is a serious risk. A person can loose feeling in the extremities within 5 minutes. Additional protective equipment such as cold water immersion suits may be required. All field staff members should be familiar with cold water survival techniques or should receive training from an American Red Cross-certified swimming instructor in cold water survival techniques when site conditions warrant such knowledge. Cold water safe work practices must be addressed in site specific safety documents.

After a person has been rescued from cold water, he or she should change into dry clothes as soon as possible. If the person who has fallen into the water displays hypothermia symptoms, he or she should be treated immediately and taken to a medical facility. Under no circumstances should the hypothermia victim be given hot liquids because this could accelerate shock. Drinks no warmer than normal body temperature are acceptable. If symptoms are severe and evacuation to a medical facility cannot be quickly conducted, any wet clothing should be removed, the victim should be placed in blankets or sleeping bags in a sheltered location, and the rescuer should climb into the blankets or sleeping bag with victim to provide additional warmth. The victim should also be treated continuously for shock, elevating feet and monitoring the victim's pulse and breathing rate.

If a team member falls into cold water, he or she should not remove any clothing while in the water because clothing provides additional insulation. Although clothing creates an added drag while swimming, the insulation outweighs the disadvantage of the additional drag. Each team member should carry a wool hat to place on his or her head in case he or she falls into the water. A wool hat, even when wet, provides good insulation for the head, where a large amount of body heat is lost.

Revision Date	Document Authorizer		Revision Details
	Name	Approval Date	
10/1/2008	Chris McClain		Update from 1998 format
	Rick Lemmon		

Tetra Tech, Inc. (Tetra Tech), conducts field work at a variety of national and international locations. Each location or work task may have unique hazards associated with it. This document identifies some unusual special hazards associated with field work and provides guidance on minimizing or preventing exposure to these hazards and should be included as an attachment to the site-specific health and safety plan, as appropriate. The following topics are discussed:

- Bear protection guidance;
- Guidance on the use of firearms;
- Remote location guidance;
- Mine hazards;
- Abandoned building guidance; and
- Aircraft hazards.

1.0 BEAR PROTECTION GUIDANCE

Tetra Tech employees may encounter "nuisance" bears typically associated with human trash dumps; however, this guidance does not address this situation because these areas will most likely have bear protection policies already in place. This policy will therefore concentrate on chance bear encounters in remote locations. Avoidance of bear encounters, reducing the possibility of injury, and prevention of the killing of bears are stressed.

For work in Alaska, the Tetra Tech field team should consult and follow the recommendations of *A Field Guide to Yukon Bears for the Exploration and Placer Industries* (field guide) published by the Yukon Wildlife Branch of the Canadian Department of Renewable Resources. This field guide provides information on bear taxonomy, habitat, and behavioral patterns, as well as recommendations on avoiding and surviving encounters. All Tetra Tech team members working at locations in Alaska where bears may be encountered must be familiar with the recommendations and information in the field guide. For work conducted in other geographical regions, similar field guides should be consulted.

Tetra Tech will also consider contracting a field guide for teams working in areas with a known risk of bear encounters. The guide will carry firearms as a last-resort defense against bears. The firearms used will be those recommended in the field guide. All persons bearing firearms must comply with the firearms policy (see Section 2.0 below). Destroying a bear will be a last-resort measure when imminent danger to field team members occurs.

Before field work begins, the Tetra Tech project manager should contact wildlife agencies that regulate the location in which Tetra Tech employees may encounter bears. Each state may have information on bear activity in their location, as well as on specific requirements that describe how wounded or destroyed bears will be managed. In Alaska, for example, the following requirements apply to destroyed bears:

- The bear must be skinned and the head removed.
- The shooting will be reported as soon as possible to the Tetra Tech project manager and to the Alaska Department of Fish and Game.
- The skin and head of any destroyed bears will be given to the Alaska Department of Fish and Game or the Division of Fish and Wildlife Protection as soon as possible.
- A written report of the circumstances leading to the shooting of the bear will be prepared and submitted to the project manager within 2 weeks of the shooting. A copy of this report will be provided to the U.S. Department of Agriculture (USDA) Forest Service.
- The Alaska Division of Fish and Wildlife Protection requires that specific forms be filled out and submitted when a bear is destroyed to protect life and property. These forms will be filled out as soon as possible after the shooting.
- If a bear is wounded but not killed, the field team should leave the area as soon as possible because wounded bears are extremely unpredictable and dangerous. The shooting and its results should be reported to the Alaska Department of Fish and Game and the Division of Fish and Wildlife Protection as soon as possible.

2.0 GUIDANCE ON THE USE OF FIREARMS

While working on Tetra Tech projects, Tetra Tech employees will not carry firearms. However, members of Tetra Tech field teams, such as guides or escorts, may carry firearms as additional protection in cases such as encounters with a bear or other dangerous wildlife. Even if they are

not carrying the firearm, all field team members will be expected to have an understanding of firearm safety. The following basic firearm safety rules will be followed at all times:

- All firearms should be treated as though they are loaded weapons until confirmation that they are not. Field team members should not accept the assurance of another person that the weapon is not loaded.
- A weapon should **never** be pointed at another person, whether the weapon is unloaded or not. Almost all accidental shootings and self-inflicted wounds result from pointing a weapon believed to be unloaded at a person.
- If the barrel of the firearm has been plugged, the firearm should not be operated before the barrel has been thoroughly cleaned. The cleaner should confirm that the weapon is **UNLOADED BEFORE CLEANING.**
- A target should always be identified before discharging the weapon. Employees should never shoot at rustling bushes or glimpses of color.
- Even if a team member is not the designated operator of the weapon, all team members should familiarize themselves with the inspection, loading, and unloading of the weapon, as well as the operation of safety catches.

Any team member violating this policy will not continue to work on the project. Any Tetra Tech employee violating this policy will also be subject to disciplinary action.

If a firearm is discharged, the circumstances of the discharge must be reported, in writing, to the project manager and operating unit health and safety manager (HSM) as soon as possible. All weapon discharge reports will be forwarded to the corporate health and safety director (CHSD) for review.

Any injury to wildlife or a field member as a result of the discharge will be reported as soon as possible to the site safety coordinator (SSC), the project manager, and the HSM. If the weapon was discharged to destroy a bear, the report of the bear destruction can be used for the firearm discharge report.

3.0 REMOTE LOCATION GUIDANCE

Job sites in remote locations are typically accessed by air or boat. As a result, quick egress is not possible. For this reason, all Tetra Tech field teams working in remote locations must prepare for several contingency situations. The two main situations of concern are medical emergencies and personnel stranded at the remote site.

All field teams will be equipped with a first aid kit that includes splints and back and neck supports, and all field staff will be trained in the use of first aid equipment. Because of the extended egress time, all personnel will be equipped with first aid supplies to treat anticipated injuries, including sprained and broken extremities; hypothermia; cuts and abrasions; and back, head, and neck injuries. Wearing proper clothing and proper footwear for the terrain is stressed to prevent injury.

Because field teams may rely on air or boat transport from the job site, bad weather or mechanical problems could result in the team having to spend one or more nights at the remote job site. In this case, all field teams should be equipped with an emergency pack that includes the following items:

- Water filtration or purification supplies;
- Freeze-dried food supplies for 3 days;
- Emergency shelter, such as a tent;
- Sleeping bags;
- Space blankets;
- Cooking utensils;
- Waterproof matches;
- Cooking stove;
- Marine radio and spare batteries;
- Flashlight or lantern; and

- Emergency flares.

With this emergency pack, the field team will be able to identify its position to rescuers and call for rescue in the case of a medical emergency. If the field team has to set up camp for the night in Alaska, the recommendations made in *A Field Guide to Yukon Bears for the Exploration and Placer Industries* will be followed. As an additional location aid, each team member should be issued a fluorescent orange vest to wear while in the woods. This fluorescent vest will aid in the location of lost or injured members of the field team.

4.0 MINE HAZARDS

Field work in locations where mining has occurred presents unique hazards. These hazards include open shafts, open drifts, abandoned structures, and abandoned explosives. Under no circumstances are Tetra Tech employees allowed to enter open shafts or drifts or abandoned structures.

If Tetra Tech personnel must inspect an area suspected to have been undermined, Tetra Tech team members must determine whether the area is safe by probing the area with a walking stick before inspecting the area. Tetra Tech team members will not walk into an area where visibility is poor without checking ground stability first.

If a team member falls into an open shaft, the remaining team members will first summon emergency aid. Because the shaft and materials surrounding the shaft may be unstable, no attempt to rescue the fallen team member should be made until emergency rescue personnel arrive on site.

If boxes of unidentified materials are present on site, all boxes will be treated as though they contain explosives. Some explosives become shock sensitive with age. Tetra Tech team members will therefore stay a minimum of 10 feet from boxes of known explosives or unknown content. The presence of any explosives observed on site will be noted and reported to the project manager, SSC, and the USDA Forest Service or other appropriate agency as soon as possible.

5.0 ABANDONED BUILDING GUIDANCE

Tetra Tech team members may investigate sites where abandoned buildings are present. Tetra Tech and team member staff should not enter abandoned buildings unless a structural engineering expert has determined that the building is structurally sound. Once inside the building, staff should watch for evidence of rodents, wild animals, poisonous insects, transients, safety hazards, and health hazards such as damaged and friable asbestos-containing materials.

6.0 AIRCRAFT HAZARDS

Tetra Tech and team member staff may be required to enter and exit either float planes or helicopters to access remote sites. Entering and exiting helicopters and float planes can be dangerous. In order to facilitate safe entry and exit from these aircraft, all Tetra Tech and team member staff will enter, exit, and load the aircraft as prescribed in the guidelines provided by the aircraft vendor. Each field team staff member will participate in a safety meeting with the pilot of each new aircraft prior to beginning work. Field team members will not exit or enter float planes until authorized by the pilot or the pilot's representative.

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	Rick Lemmon		

This safe work practice (SWP) applies to portable ladders only. Fixed ladder systems shall be used when regular access is required such as for entering storage tanks and raised work platforms. These SWPs follow the regulatory requirements for ladders as found in Title 29 of the *Code of Federal Regulations* (CFR) Part 1926.1053. Procedures to ensure portable ladder safety are listed below.

- Ladders should be maintained in good condition at all times. Damaged ladders shall be withdrawn from service immediately.
- Ladders should be inspected regularly and removed from service and repaired or discarded if defective.
- Rungs should have slip-resistant surfaces and be kept free of grease and oil.
- Tops and pail shelves of portable stepladders should not be used as steps.
- Rung and cleat ladders should be placed so that the horizontal distance from the top support to the foot of the ladder is one-quarter of the working length of the ladder.
- Ladders should not be placed in front of doorways, drives, or passageways.
- Ladders should not be placed on boxes, barrels, or other unstable bases to add height.
- Employees should always face the ladder during ascent or descent.
- Metal ladders should not be used in areas with the potential for contact with electric circuits.
- Ladder side rails shall extend at least 3 feet above the upper landing surface to which the ladder is used to access.
- Ladder shall be used only on stable and level surfaces and secured. Do not use ladders on slippery surfaces.

Disclaimer: This safe work practice (SWP) is the property of Tetra Tech, Inc. (Tetra Tech). Any reuse of the SWP without Tetra Tech's permission is at the sole risk of the user. The user will hold harmless Tetra Tech for any damages that result from unauthorized reuse of this SWP. Authorized users are responsible for obtaining proper training and qualification from their employer before performing operations described in this SWP.

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This safe work practice (SWP) describes situations where heat stress is likely to occur and provides procedures for the prevention and treatment of heat-related injuries and illnesses. Wearing personal protective equipment (PPE), especially during warm weather, puts employees at considerable risk of developing heat-related illness. Health effects from heat stress may range from transient heat fatigue or rashes to serious illness or death.

Many factors contribute to heat stress, including PPE, ambient temperature and humidity, workload, and the physical condition of the employee, as well as predisposing medical conditions. However, the primary factors are elevated ambient temperatures in combination with fluid loss. Because heat stress is one of the more common health concerns that may be encountered during field activities, employees must be familiar with the signs, symptoms, and various treatment methods of each form of heat stress. Heat stroke is the most serious heat-related illness–it is a threat to life and has a 20 percent mortality rate. Direct exposure to sun, poor air circulation, poor physical condition, and advanced age directly affect the tendency to heat stroke. Table 1 lists the most serious heat conditions, their causes, signs and symptoms, and treatment.

Training is an important component of heat stress prevention. Employees are instructed to recognize and treat heat-related illnesses during 8-hour health and safety refresher and first aid training courses. When working in hot environments, specific steps should be taken to lessen the chances of heat-related illnesses. These include the following:

- Ensuring that all employees drink plenty of fluids (Gatorade® or its equivalent)
- Ensuring that frequent breaks are scheduled so overheating does not occur
- Revising work schedules, when necessary, to take advantage of the cooler parts of the day (such as working from 5:00 a.m. to 11:00 a.m. and 6:00 p.m. to nightfall).

When PPE must be worn (especially Levels A and B), suggested guidelines relating to ambient temperature and maximum wearing time per excursion are as shown in Table 2.

TABLE 1
HEAT STRESS CONDITIONS

Condition	Causes	Signs and Symptoms	Treatment
Heat cramps	Fluid loss and electrolyte imbalance from dehydration	• Painful muscle cramps, especially in legs and abdomen • Faintness • Profuse perspiration	• Move affected worker to cool location • Provide sips of liquid such as Gatorade® • Stretch cramped muscles • Transport affected worker to hospital if condition worsens
Heat Exhaustion	Blood transport to skin to dissipate excessive body heat, resulting in blood pooling in the skin with inadequate return to the heart	• Weak pulse • Rapid and shallow breathing • General weakness • Pale, clammy skin • Profuse perspiration • Dizziness • Unconsciousness	• Move affected worker to cool area • Remove as much clothing as possible • Provide sips of cool liquid or Gatorade® (only if conscious) • Fan the person but do not overcool or chill • Treat for shock • Transport to hospital if condition worsens
Heat Stroke	Life threatening condition from profound disturbance of body's heat-regulating mechanism	• Dry, hot, and flushed skin • Constricted pupils • Early loss of consciousness • Rapid pulse • Deep breathing at first, and then shallow breathing • Muscle twitching leading to convulsions • Body temperature reaching 105 or 106 °F or higher	• Immediately transport victim to medical facility • Move victim to cool area • Remove as much clothing as possible • Reduce body heat promptly by dousing with water or wrapping in wet cloth • Place ice packs under arms, around neck, at ankles, and wherever blood vessels are close to skin surface • Protect patient during convulsions

TABLE 2
SUGGESTED GUIDELINES WHEN WEARING PPE

Ambient Temperature	Maximum PPE Wearing Time per Excursion
Above 90 °F	15 minutes
85 to 90 °F	30 minutes
80 to 85 °F	60 minutes
70 to 80 °F	90 minutes
60 to 70 °F	120 minutes
50 to 60 °F	180 minutes

Source: National Institute for Occupational Safety and Health (NIOSH). 1985. Memorandum Regarding Recommended Personal Protective Equipment Wearing Times at Different Temperatures. From Austin Henschel. To Sheldon Rabinovitz. June 20.

To monitor the level of an employee's heat stress, the following should be measured:

- Heart Rate: Count the radial (wrist) pulse during a 30-second period as early as possible in the rest period; if heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same.

  If the heart rate still exceeds 110 beats per minute at the next period, shorten the following work cycle by one-third.

- Oral Temperature: Use a clinical thermometer (3 minutes under the tongue) to measure the oral temperature at the end of the work period. If oral temperature exceeds 99.6 °F (37.6 °C), shorten the next work cycle by one-third without changing the rest period. If oral temperature still exceeds 99.6 °F at the beginning of the next rest period, shorten the following work cycle by one-third. Do not permit a worker to wear impermeable PPE when his or her oral temperature exceeds 100.6 °F (38.1 °C).

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This safe work practices (SWP) describes situations where cold stress is likely to occur and discusses procedures for the prevention and treatment of cold-related injuries and illnesses. Cold conditions may present health risks to employees during field activities. The two primary factors that influence the risk potential for cold stress are temperature and wind velocity. Wetness can also contribute to cold stress. Other factors that increase susceptibility to cold stress include age (very young or old), smoking, alcohol consumption, fatigue, and wet clothing. Hypothermia can occur at temperatures above freezing if the individual has on wet or damp clothing or is immersed in cold water. The combined effect of temperature and wind can be evaluated using a wind chill index as shown in Table 1.

Bare flesh and body extremities that have high surface area-to-volume ratios such as fingers, toes, and ears are most susceptible to wind chill or extremely low ambient temperatures. Because cold stress can create the potential for serious injury or death, employees must be familiar with the signs and symptoms and various treatments for each form of cold stress. Table 2 provides information on frostbite and hypothermia, the two most common forms of cold-related injuries.

Training is an essential component of cold stress prevention. Employees are instructed to recognize and treat cold-related injuries during 8-hour health and safety refresher and first aid training courses. When working in cold environments, specific steps should be taken to lessen the chances of cold-related injuries. These include the following:

- Protecting of exposed skin surfaces with appropriate clothing (such as face masks, handwear, and footwear) that insulates, stays dry, and blocks wind;
- Shielding the work area with windbreaks to reduce the cooling effects of wind;
- Providing equipment for keeping workers' hands warm by including warm air jets and radiant heaters in addition to insulated gloves;
- Using adequate insulating clothing to maintain a body core temperature of above 36 °C;
- Providing extra insulating clothing on site;
- Reducing the duration of exposure to cold; and
- Changing wet or damp clothing as soon as possible.

During periods of extreme cold (10 °F or less) workers should use the buddy system to ensure constant protective observation.

Specific monitoring criteria are not established for cold stress. However, employees should be thoroughly cognizant of the signs and symptoms of frostbite and hypothermia (see Table 1) in themselves as well as in coworkers. All instances of cold stress should be reported to the site safety coordinator. Work schedules may be adjusted and warm-up regimes imposed as needed to deal with temperature and wind conditions.

TABLE 1
COOLING POWER OF WIND ON EXPOSED FLESH EXPRESSED AS EQUIVALENT TEMPERATURE

Estimated Wind Speed (in miles per hour - mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (°F)											
CALM	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	*LITTLE DANGER* in less than 1 hour with dry skin; maximum danger from false sense of security				*INCREASING DANGER* from freezing of exposed flesh within 1 minute				*GREAT DANGER* that flesh may freeze within 30 seconds			
	Trench foot may occur at any point on this chart.											

Source: Modified from American Conference of Governmental Industrial Hygienists. 1997. "Threshold Limit Values for Chemical Substances and Physical Agents."

TABLE 2
COLD STRESS CONDITIONS

Condition	Causes	Signs and Symptoms	Treatment
Frostbite	Freezing of body tissue, usually the nose, ears, chin, cheeks, fingers, or toes	• Pain in affected area that later goes away • Area feels cold and numb • Incipient frostbite (frostnip) - skin is blanched or whitened and feels hard on the surface • Moderate frostbite - large blisters • Deep frostbite - tissues are cold, pale, and hard	• Move affected worker to a warm area • Immerse affected body part in warm (100 to 105 °F) water—not hot! • Handle affected area gently; do not rub • After warming, bandage loosely and seek immediate medical treatment
Hypothermia	Exposure to freezing or rapidly dropping temperatures	• Shivering, dizziness, numbness, weakness, impaired judgment, and impaired vision • Apathy, listlessness, or sleepiness • Loss of consciousness • Decreased pulse and breathing rates • Death	• Immediately move affected person to warm area • Remove all wet clothing and redress with loose, dry clothes • Provide warm, sweet drinks or soup (only if conscious) • Seek immediate medical treatment

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Biological hazards, or "biohazards," include plants, animals or their products, and parasitic or infectious agents that may present potential risks to worker health. This safe work practice (SWP) discusses procedures for working with biohazards, preventive guidelines, and first-aid procedures for the most common hazards field staff are likely to encounter. This SWP does not address biohazards such as those associated with medical waste. Procedures for working with this type of biohazard should be addressed in the site-specific health and safety plan (HASP), construction health and safety plan (C-HASP), job safety analyses (JSAs), activity hazard analyses (AHAs), or other health and safety project planning documents on a case-by-case basis.

During preparation for site work, the document preparer should consider which plants, animals, and other biological agents may be encountered; assess their potential risk to project personnel; and attach this SWP to the document if necessary. Office health and safety representatives should become familiar with biological hazards indigenous to the geographical area in which most of their office personnel work and assist in evaluating the risks to personnel on projects staffed from their offices. SWPs for insects, snakes, animals, plants, waterborne pathogens (giardia), and hantavirus are provided below.

1.0 INSECTS

SWPs for reducing the chance of insect bites or stings and for treating bites or stings are listed below.

- Workers should keep as much skin area covered as possible by wearing long-sleeved shirts, long pants, and a hat. Pant legs should be tucked into socks or boots and shirts into pants. In addition, workers should wear light colored clothing.
- A proven insect repellent should be used on bare skin and clothing.
- When possible, tall grasses and brush that could harbor ticks should be avoided.
- Several times during the day and at the end of the work day, each worker should perform a check for evidence of imbedded ticks or previous bites. Particular attention should be paid to the scalp, neck, ankles, back of the legs, and waist.

- When opening well covers, vaults, or other closed items, workers should watch for hornet or wasp nests and black widow or brown recluse spiders. Workers should never reach into spaces with unprotected arms.
- Workers should watch carefully for bees around open soft drinks or food.
- If a worker is stung by a bee, the stinger should be carefully removed, if present. The wound should be washed and a cold pack applied. Allergic reaction should be watched for and is evidenced by extreme swelling, redness, pain, or difficulty breathing.
- If a worker is stung or bit by a spider or scorpion, medical attention should be obtained immediately.

2.0 SNAKES

SWPs for encounters with snakes and for treating snakebites are listed below.

- Workers should avoid walking in areas known to harbor snakes. Workers should be cautious when picking up or moving items that have been on the ground.
- Workers should wear boots made of heavy material that protect the ankles and pants. Heavy work gloves should be worn for picking up items.
- If one snake is encountered, others may be present. Workers should leave the area by retracing their steps.
- If a worker is bitten, the wound should be washed and the injured area immobilized and kept lower than the heart, if possible. Ice or a tourniquet should not be applied to a snake bite. The wound should not be cut. If medical care is more than 30 minutes away from a work site, a snakebite kit should be available on site and workers should know how to use it.

3.0 ANIMALS

SWPs for encounters with animals and for treating associated wounds are listed below.

- If workers encounter a wild animal, the animal should be observed for unusual behavior such as a nocturnal animal out during the day, drooling, an appearance of partial paralysis, irritability, meanness, or a strangely quiet demeanor.

- Workers should never touch the body of a dead animal because certain diseases could be carried by fleas still on the body.

- Workers should avoid animal droppings (including bird droppings). Pathogens, some of which can become airborne, may still be present in the droppings.

- If a worker is bitten, he or she should get away from the animal to avoid further bites. Workers should not try to stop, hold, or catch the animal.

- If the wound is minor, it should be washed with soap and water. Any bleeding should then be controlled, and an antibiotic ointment and dressing should be applied. All animal bite wounds should be watched for signs of infection.

- If the wound is bleeding seriously, the bleeding should be controlled but the wound should not be cleaned. Medical assistance should be summoned immediately.

- If a rabid animal is suspected, immediate medical attention should be summoned. If possible, workers should try to remember what the rabid animal looked like and the area in which it was last seen. The animal should be reported by calling the local emergency number.

4.0 PLANTS

SWPs for plants are as follows:

- Workers should be aware of the types and appearances of poisonous plants in the work site area. Poison ivy, oak, and sumac are the most frequently encountered plants that can cause reaction from casual contact. If a worker is extremely sensitive to these plants, he or she should avoid the area entirely because airborne drift could be sufficient to cause a reaction. Other plants, such as fireweed, can cause painful, short-term irritation and should be avoided as well. Workers should avoid touching face and eye areas after contact with any suspicious plant.

- Workers should wear proper clothing if working in or near overgrown areas. Disposable outerwear should be used, if necessary, and workers should not touch the material with bare hands during removal if the outerwear may have contacted poisonous plants.

- If contact with a poisonous plant has occurred, the affected area should be immediately washed thoroughly with soap and water. If a rash or weeping sore has already begun to develop, a paste of baking soda and water should be applied to the area several times a day to reduce discomfort. Lotions such as Calamine or Caladryl should be applied to help soothe the area. If the condition gets worse and affects large areas of the body or the face, a doctor should be consulted.

- Bushy and wooded areas should be thoroughly checked for thorn-bearing trees, brush, and bramble. In some cases, impalement can cause severe pain or infection.

5.0 WATERBORNE PATHOGENS-GIARDIA

Giardia is a waterborne pathogen consisting of a protoplasmic parasite of the mammalian digestive tract. Giardia is present worldwide, with the highest occurrence in areas with poor sanitation. In the United States, most reported cases are in mountainous regions where drinking water is obtained from streams and is unfiltered or untreated.

Giardia is contracted by ingesting water contaminated with giardia cysts in the dormant state. Giardia parasites can only thrive in the digestive tracts of mammals. Dormant giardia organisms enter water through the feces of infected animals or humans. Giardia symptoms include severe diarrhea and upset stomach. Some people are asymptomatic but can transmit the disease to others. Medical treatment of giardia can be difficult and unpleasant; therefore, prevention is critical. Precautions for preventing exposure to giardia are listed below.

- Workers should assume that all fresh water streams are infected with the giardia organism and not drink any <u>untreated</u> water.

- Team members collecting sediment and water samples from streams should wash their hands thoroughly with soap and water after collecting the samples.

- Giardia parasites are relatively easy to destroy or filter. Water should be treated for drinking or cooking with iodine or another recommended giardia treatment before use.

6.0 HANTAVIRUS

Hantavirus pulmonary syndrome (HPS) is a potentially fatal infection caused by a rodent-borne hantavirus. HPS begins with a brief illness most commonly characterized by fever, muscle pain, headache, coughing, and nausea or vomiting. Other early symptoms include chills, diarrhea, shortness of breath, abdominal pain, and dizziness. In the first identified cases of HPS, this stage of the infection lasted 2 to 5 days before victims were hospitalized. Typically, by the time of hospitalization, victims were found to have tachycardia (a heart rate of greater than 100 beats per minute) and tachypnea (a breathing rate of greater than 20 breaths per minute). Fever was also common. In most cases, death occurred within 2 to 16 days of the onset of symptoms, and victims exhibited pulmonary edema and severe hypotension.

Currently, experts believe that HPS is spread by the deer mouse (*Peromyscus maniculatus*). Though the deer mouse has been found to be the primary host of hantavirus, several other rodent species have also tested positive for the virus. Pinon mice (*Peromyscus truei*), brush mice (*Peromyscus boylii*), and western chipmunks (*Tamia spp.*) are also likely to carry the virus. Also, cases of HPS have been reported in areas of the United States where these particular rodents are not indigenous.

Infected rodents shed the virus in their urine, feces, and saliva. Humans can be exposed to the virus through (1) inhalation of suspended rodent excreta or dust particles containing rodent excreta, (2) introduction of rodent excreta into the eyes or broken skin, and (3) ingestion of food or water contaminated by rodent excreta. HPS has a reported mortality rate of 55 percent. Transmission of hantavirus from infected individuals to healthy persons has not been documented.

Prevention of HPS infection is essential because no known antidote and no specific treatment exists for treating HPS. Therefore, employees should practice risk reduction and control measures. Guidelines for workers in locations that may have rodent infestations or habitats are listed below.

- The best approach for HPS control and prevention is through environmental hygiene practices that deter rodents from colonizing the work environment.

- Information about the symptoms of HPS and detailed guidance on preventive measures should be provided to all employees assigned to field activities.

- Medical attention should be sought immediately for workers who develop a febrile or respiratory illness within 45 days of the last potential exposure to rodents. Attending physicians should be advised of each worker's potential for occupational exposure to hantavirus. Physicians should contact local health authorities promptly if hantavirus-associated illness is suspected. A blood sample should be obtained from the affected worker and forwarded with the baseline serum sample through the state health department to the Centers for Disease Control and Prevention for hantavirus antibody testing.

- Respiratory protective equipment should be worn when handling rodents, when removing rodents from traps, and when working in areas with evidence of rodent droppings or hair. Respiratory protective equipment should include, at a minimum, a half-face air-purifying respirator (APR) or powered APR equipped with a high-efficiency particulate air (HEPA) filter (P100). Full-face regulators may be needed under some circumstances. Respiratory protective equipment should be used in accordance with Occupational Safety and Health Administration regulations.

- Dermal protection should be worn when handling rodents or traps containing rodents, or if contact with contaminated surfaces could occur. Dermal protection should include rubber or plastic gloves that should be washed and disinfected before removal.

- A trap contaminated with rodent urine or feces or in which a rodent was captured should be disinfected with a commercial disinfectant or a 0.4 percent bleach solution. A dead rodent should be disposed of by placing the carcass in a plastic bag containing enough general-purpose household disinfectant to thoroughly wet the carcass. The bag should be sealed and disposed of by burning or by burying it in a 2- to 3-foot-deep hole. Local and state health departments can also provide appropriate disposal methods.

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To prevent injuries and adverse health effects, the following general safe work practices (SWP) are to be followed when lifting and carrying while in an office or field environment. These SWPs establish a pattern of general precautions and measures for reducing risks associated with back injury and trauma associated with improper lifting and carrying of heavy objects. This list is not inclusive and may be amended as necessary.

- First, inspect the area where the load will be lifted, transported, and then deposited. Remove any obstacles that could present a tripping or other hazard.
- Perform a "test lift" by slightly pushing or moving the object to gauge your ability to safely lift/move/deposit the item without injuring yourself. IF YOU ARE NOT CONFIDENT THAT YOU CAN MOVE THE OBJECT WITHOUT INJYURING YOURSELF - THEN EITHER GET A MECHANICAL LIFTING AID OR GET HELP. DO NOT ATTEMPT TO MOVE THE OBJECT YOURSELF.
- Get as close to the object as you can, and bend at the knees (not at the back).
- Assure that can get a firm grasp on the object.
- Keeping the load as close to you body as possible, lift with your legs, and avoid turning or twisting while lifting, carrying, or depositing the load.
- Carry the object in a manner that it does not obstruct your vision and so that you can maintain a clear line of sight of your path of travel and the area where you will set it down.
- Set the object down using the same techniques as you did in lifting it (don't turn or twist, keep it close to your body, use your legs - not your back).

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	TETRA TECH, INC. PREVENTION of SUN EXPOSURE	Revision Date: 10/1/2008
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By far, the most common cause of skin cancer is overexposure to the sun. Ninety percent of all skin cancers occur on parts of the body that not usually covered by clothing. People who sunburn easily, and those with fair skin and red or blond hair are more prone to develop skin cancer. The amount of time spent in the sun also affects a person's risk of skin cancer. Premature aging of the skin also occurs with prolonged sun exposure. Tetra Tech encourages personnel to avoid prolonged exposure to the sun, and recommends the following:

- Sunburn can occur during any time of the year. To avoid sunburn, wear hats with wide brims.
- Use sunscreen with a Sun Protective Factor (SPF) rating of 15 or higher.
- To prevent skin cancer:
  - Cover up with a wide brimmed hat and a bandanna for your neck. Wear long-sleeved shirts and pants which the sun cannot penetrate.
  - Use sunscreens to help prevent skin cancer as well as premature aging of your skin. Use a Sun Protective Factor (SPF) rating of 15 or higher.
  - Apply sunscreen at least an hour before going into the sun and again after swimming or perspiring a lot.
  - Do not use indoor sun lamps, tanning salons/parlors, or tanning pills.
- You can still get burned on a cloudy day. Try to stay out of the direct sun at midday, because sun rays are their strongest between 10 a.m. and 3 p.m. Beware of high altitudes - where there is less atmosphere to filter out the ultraviolet rays. Skiers should remember that snow reflects the sun's rays, too.
- Know your skin. Whatever your skin type, do a monthly self-examination of your skin to note any moles, blemishes or birthmarks. Check them once a month and if you notice any changes in size, shape or color, or if a sore does not heal, see your physician without delay.

Revision Date	Document Authorizer		Revision Details
	Name	Approval Date	
10/1/2008	Chris McClain		NEW
	Rick Lemmon		

This safe work practice (SWP) provides guidelines for proper and thorough cleaning of respiratory protection equipment. The Occupational Safety and Health Administration (OSHA) regulates the use of respiratory protection for general industry in Title 29 of the *Code of Federal Regulations* (CFR) Part 1910.134, "Respiratory Protection." Appendix B-2 of the standard outlines mandatory requirements for respirator cleaning and is used as the basis for this SWP. This SWP supplements Document Control Number (DCN) 2-6, "Respiratory Protection Program." It provides specific respirator cleaning and disinfection procedures and shall be included as an attachment to the site-specific health and safety plan for projects for which respirator use is planned or is a contingency.

1.0 APPLICABILITY

This SWP shall apply to any project that involves use of respirators with reusable facepieces.

Respirators shall be cleaned and disinfected as discussed below.

- Respirators issued for the exclusive use of an employee shall be cleaned and disinfected as often as necessary to be maintained in a sanitary condition.
- Respirators issued to more than one employee shall be cleaned and disinfected before being worn by different individuals.
- Respirators maintained for emergency use shall be cleaned and disinfected after each use.
- Respirators used in fit testing and training shall be cleaned and disinfected after each use.

2.0 CLEANING AND DISINFECTION PROCEDURES

Mandatory respirator cleaning procedures as defined in 29 CFR Part 1910.134, Appendix B-2, are listed below. All wash and rinse water should be warm, with a maximum temperature of 110 °F (43 °C).

1. Remove filters, cartridges, or canisters. Disassemble facepieces by removing speaking diaphragms, demand and pressure-demand valve assemblies, hoses, and any other components as recommended by the manufacturer. Discard or repair any defective parts.

2. Wash components in warm water with a mild detergent or with a cleaner recommended by the manufacturer. A stiff bristle (not wire) brush may be used to facilitate the removal of dirt.

3. Rinse components thoroughly in clean, warm, preferably running water. Drain all components.

4. When the cleaner does not contain a disinfecting agent, respirator components should be immersed for 2 minutes in one of the following:

   - Hypochlorite solution [50 parts per million (ppm) of chlorine] made by adding approximately one milliliter of laundry bleach to 1 liter of warm water

   - Aqueous solution of iodine [50 ppm iodine made by adding approximately 0.8 milliliter of tincture of iodine (6 to 8 grams ammonium and/or potassium iodide per 100 cubic centimeters of 45 percent alcohol) to 1 liter of warm water]

   - Other commercially available cleansers of equivalent disinfectant quality when used as directed if their use is recommended or approved by the respirator manufacturer

5. Rinse components thoroughly in clean, warm, preferably running water. Drain all components. The importance of thorough rinsing cannot be over emphasized. Detergents or disinfectants that dry on facepieces may cause dermatitis. In addition, some disinfectants may cause deterioration of rubber or corrosion of metal parts if not completely removed.

6. Components should be air-dried or hand-dried with a clean, lint-free cloth.

7. Reassemble the facepiece. Replace filters, cartridges, and canisters prior to next use.

8. Test the respirator to ensure that all components work properly.

9. Place the respirator in a clean bag and seal for storage.

Depending on work conditions, respirator facial sealing surfaces may need periodic cleaning during the course of daily use. Cleaning of the facial sealing surface during work breaks can reduce the chance of facial irritation caused by sweat, natural skin oil, or irritating materials that may have deposited on the facepiece. Facial sealing surfaces can be cleaned using disinfectant wipes soaked in isopropyl alcohol or benzalkonium chloride. After use of the disinfectant wipe, the sealing surface should air dry or be dried thoroughly using paper towels or tissues.

Revision Date	Document Authorizer		Revision Details
	Name	Approval Date	
10/1/2008	Chris McClain		Update from 1998 format
	Rick Lemmon		

This safe work practice (SWP) was developed to ensure the proper use of respirators in routine and foreseeable emergency situations. The SWP supplements Document Control No. 2-6, "Respiratory Protection Program." This SWP shall be included as an attachment to the site-specific health and safety plan (HASP) for projects for which respirator use is planned or is a contingency.

1.0 APPLICABILITY

This SWP shall apply to any project that involves use of air purifying respirators and shall not be used for situations involving the use of supplied air systems such as self-contained breathing apparatuses and air-line apparatuses.

2.0 ROUTINE RESPIRATOR USE PROCEDURES

The procedures below apply to the routine use of air purifying respirators.

- Respirators shall not be issued to or worn by individuals when conditions prevent valve function or a good facial seal. These conditions may include but are not limited to facial hair, such as the growth of beard, sideburns, or excessive mustaches, and possibly the wearing of corrective eyeglasses.
- If spectacles, goggles, face shields, or welding helmets must be worn with a facepiece, they will be worn so as not to adversely affect the seal of the facepiece to the face.
- For all tight-fitting respirators, a positive and negative pressure seal check shall be performed each time the respirator is donned. Seal checks shall be performed as follow:
  - *Negative pressure check:* Close off the inlet opening of the canister or cartridge(s) by covering it with the palm of the hand(s), inhale gently so that the facepiece collapses slightly, and hold the breath for 10 seconds. If the facepiece remains in its slightly collapsed condition and no inward leakage of air is detected, the tightness of the respirator is satisfactory.
  - *Positive pressure check*: Close off the exhalation valve and exhale gently into the facepiece. The face fit is considered satisfactory if a slight positive pressure can be built up inside the facepiece without any evidence of outward leakage of air at the seal. The exhalation valve cover may have to be removed to perform this procedure.

- *Manufacturer's recommended seal check*: If the respirator manufacturer recommends specific procedures for performing a user seal check, these procedures may be used instead of the negative and positive pressure checks.

- Work areas must be monitored for conditions that may adversely affect the effectiveness of respiratory protection. Employees may leave the work area where respirators are required under the following conditions:

  - To wash the face and respirator facepieces as necessary to prevent eye or skin irritation;
  - If vapor or gas breakthrough, changes in breathing resistance, or leakage of the facepiece is detected;
  - To replace the respirator or the filter, cartridge, or canister elements;
  - If established monitoring instrument action levels are exceeded; or
  - For any other criteria as established in a site-specific health and safety plan (HASP), construction health and safety plan (C-HASP), job hazard analysis (JHA), job safety analysis (JSA), work permit or other site-specific health and safety document.

3.0 RESPIRATOR USE DURING EMERGENCY SITUATIONS

Emergency situations may arise during the wearing of respiratory protection. These situations could include medical emergency, respirator failure, fire, chemical spills or leaks, and other events that pose an immediate risk. Procedures for respirator use during emergency situations are summarized below.

- When an emergency situation arises that creates or has the potential to create immediately dangerous to life and health (IDLH) conditions, the work environment shall be evacuated immediately and shall not be reentered by employees without suitable protective gear.

- Work environments with the potential for the development of atmospheres that may present IDLH conditions shall only be entered by employees using the buddy system.

- When an emergency situation arises that includes physical hazards that may interfere with the proper use of respiratory protection, the work environment shall be evacuated.
- Under no circumstances shall respirator users remove facepieces in hazardous atmospheres. In the event of respirator malfunction, users should leave the hazardous environment immediately and proceed to a known safe location before removal of the facepiece.
- Episodes of respirator failure shall be thoroughly investigated before work activities begin again. The investigation shall include re-evaluation of work area atmospheric conditions, review of the respirator selection criteria and service life calculations, and an evaluation of the working conditions under which respirator failure occurred.

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	Rick Lemmon		

The safe work practice (SWP) addresses the need for proper and thorough procedures for qualitative fit testing of respirators. The Occupational Safety and Health Administration (OSHA) regulates general industrial use of respiratory protection under Title 29 of the *Code of Federal Regulations* (CFR), Part 1910.134. Appendix A of the standard outlines mandatory procedures to use for both qualitative fit tests (QLFT) and quantitative fit tests (QNFT). This SWP was written in accordance with the requirements of Appendix A for QLFTs. This SWP must be used in conjunction with the Tetra Tech, Inc. (Tetra Tech), "Respiratory Protection Program," Document Control Number (DCN) 2-6.

The following sections describe the SWP's applicability, qualifications of fit testers, and fit testing procedures for use during QLFTs.

1.0 APPLICABILITY

This SWP applies to all Tetra Tech employees who use respirators on the job and to employees who conduct any fit testing. In addition, when a Tetra Tech company or office uses an outside service to perform fit testing, the organization conducting the fit testing shall meet the minimum requirements for QLFT and QNFT procedures specified in Appendix A of the standard.

Respirator fit testing shall be conducted at the following intervals:

- Prior to initial use of a respirator;
- Whenever a different respirator facepiece (size, style, model, or make) is used;
- At least annually thereafter; or
- After any reported or observed changes in an employee's physical condition that could affect respirator fit. This includes but is not limited to, facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight.

If an employee notices that the fit of a respirator has become unacceptable, he or she will be given an opportunity to select another respirator facepiece.

2.0 QUALIFICATION OF FIT TESTERS

Tetra Tech employees who conduct QLFTs must demonstrate sufficient understanding and expertise in the required testing procedures. Fit testers shall qualify through appropriate education, experience, or both. Qualifications of fit testers shall be determined on a case-by-case basis by operating unit health and safety managers (HSMs) based on the fit tester's demonstrated knowledge of OSHA-mandated fit test procedures and performance of a simulated fit test. The HSM must ensure that persons administering fit tests are able to prepare test solutions, calibrate and operate equipment, perform tests properly, recognize invalid tests, and ensure that test equipment is in proper working order. The fit tester must also demonstrate how to clean and maintain equipment to operate within the parameters for which it was designed.

3.0 FIT TESTING PROCEDURES

Appendix A of 29 CFR 1910.134 provides instruction for five OSHA-accepted QLFT procedures. Tetra Tech has selected two of these procedures for its fit-test program. The sections below describe general requirements that must be followed during all fit tests and for any fit test method used. The Both Bitrex™ QLFT protocol is discussed below.

3.1 General Requirements

QLFTs must be conducted in accordance with the general requirements discussed below.

- The test subject shall be shown how to put on a respirator, position it on the face, set strap tension, and determine an acceptable fit. A mirror shall be available to assist the subject in evaluating the fit and positioning the facepiece.

- The test subject must be allowed to choose from a sufficient selection of models and sizes to identify a respirator that fits correctly and is comfortable. The subject shall be informed that he or she is being asked to select the respirator that provides the most acceptable fit. The subject shall be asked to hold each chosen facepiece up to the face and eliminate those that obviously do not provide an acceptable fit.

- The subject shall don the most comfortable respirator and wear it for at least 5 minutes to assess comfort. If the subject is not familiar with a particular respirator, the subject shall be directed to don the mask several times and to adjust the straps each time to become adept at setting proper strap tension.

- The tester shall review the following points with the subject and allow the subject adequate time to determine the comfort of the respirator:

  – Position of the mask on the nose

- Room for eye protection
- Ability to talk
- Position of the mask on the face and cheeks

- The following criteria shall be used to help determine the adequacy of the respirator fit:
  - Chin properly placed
  - Adequate strap tension (not overly tight)
  - Fit across nose bridge
  - Proper size to span distance from nose to chin
  - Tendency of respirator to slip
  - Self-observation in a mirror to evaluate fit and respirator position

- The subject shall conduct a user seal check using the negative- and positive-pressure seal check procedures described in Appendix A of this SWP. Before conducting the check, the subject shall be instructed to seat the mask on the face by moving the head from side to side and up and down slowly while taking a few slow, deep breaths. If the seal checks fail, the subject shall choose another facepiece.

- Seal checks and fit testing shall not be conducted if there is any facial hair growth such as stubble beard growth, beard, mustache, or sideburns that interferes with the facepiece sealing surface. Any interfering apparel shall be altered or removed.

- If the subject experiences difficulty in breathing during testing, the testing shall stop immediately and he or she shall be referred to a company physician for assessment.

- If the subject finds the fit of the respirator unacceptable, the subject shall be given the opportunity to select a different respirator and to be retested.

- Prior to commencement of the fit test, the subject shall be given a written description of the respirator user seal check procedures (see Appendix A) and exercises to perform during the testing. Exercises and a prepared text to be read during the test are included in Appendix B of this SWP.

- All exercises in Appendix B must be performed for all QLFT methods.

3.2 BITREX™ Solution Qualitative Fit Test Protocol

Bitrex™ solution (denatonium benzoate) is a taste aversion agent. To conduct a QLFT using Bitrex™, the test subject must first pass a taste threshold screening. The entire procedure must be explained to the test subject before the screening is conducted. The sections below describe taste threshold screening and fit test procedures. Particulate filters (cartridges) are used during this test.

3.2.1 Taste Threshold Screening

The taste threshold screening is intended to determine whether the individual tested can detect the taste of Bitrex™. The procedures below shall be used for the taste screening.

- Prior to testing, the tester shall prepare a quantity of threshold check solution by adding 13.5 milligrams (mg) of Bitrex™ to 100 milliliters (mL) of 5 percent salt solution in distilled water. A nebulizer for taste screening shall be clearly marked to distinguish it from the fit test solution nebulizer. The taste screening nebulizer shall be thoroughly rinsed in water, shaken to dry, and refilled at least each morning and afternoon or at least every 4 hours.

- During the taste screening as well as during the fit testing, subjects shall wear an enclosure around the head and shoulders that is approximately 12 inches in diameter by 14 inches tall. The front portion of the enclosure shall be clear from the respirator and allow free movement of the head when a respirator is worn. An enclosure substantially similar to the 3M hood assembly, parts #14 and #15 combined, is adequate.

- The test enclosure shall have a 0.75-inch hole in front of the test subject's nose and month area to accommodate the nebulizer nozzle.

- The test subject shall don the test enclosure. Throughout the threshold screening test, the test subject shall breathe through his or her slightly open mouth with tongue extended. The subject is instructed to report when he or she detects a bitter taste.

- Using a DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent, the test conductor shall spray the threshold check solution into the enclosure. To produce the aerosol, the nebulizer bulb is firmly squeezed so that the bulb collapses completely. The bulb is then released and allowed to fully expand. Correct use of the nebulizer means that approximately 1 mL of liquid is used at a time in the nebulizer body.

- The nebulizer should be rapidly squeezed 10 times and then the test subject is asked whether the Bitrex™ solution can be tasted. If the subject reports tasting the bitter taste during the 10 squeezes, the screening test is complete. The taste threshold is noted as 10 regardless of the number of squeezes actually completed.

- If the first response is negative, the nebulizer is rapidly squeezed 10 more times and the test subject is again asked whether the Bitrex™ solution is tasted. If the test subject reports tasting the bitter taste during the second 10 squeezes, the screening test is completed. The taste threshold is noted as 20 regardless of the number of squeezes actually completed.

- If the second response is negative, the nebulizer is rapidly squeezed 10 more times and the test subject is again asked whether the Bitrex™ solution is tasted. If the test subject reports tasting the bitter taste during the third 10 squeezes, the screening test is completed. The taste threshold is noted as 30 regardless of the number of squeezes actually completed.

- If the Bitrex™ solution is not tasted after 30 squeezes, the test subject is unable to taste the Bitrex™ solution and cannot be fit tested using the Bitrex™ solution test.

- The tester will note the number of squeezes required to solicit a taste response. When a taste response has been elicited, the test subject shall be asked to note the taste for reference in the fit test.

3.2.2 Bitrex™ Solution Fit Test Procedures

The procedures below must be followed to conduct the actual Bitrex™ solution fit test:

- A fit test solution is prepared by adding 337.5 mg of Bitrex™ to 200 mL of a 5 percent salt solution in warm water. A second nebulizer dedicated to fit testing shall be clearly marked to distinguish it from the taste screening solution nebulizer. The nebulizer shall be thoroughly rinsed in water, shaken to dry, and refilled at least each morning and afternoon or at least every 4 hours.

- The test subject shall be instructed not to each, drink, smoke, or chew gum for 15 minutes before the test.

- The person being fit tested shall don the respirator without assistance and perform the required user seal check (see Appendix A).

- The fit test uses the same enclosure described for taste threshold screening in Section 3.2.1. The test subject shall don the enclosure while wearing the respirator selected as described in the general requirements in Section 3.1. The respirator shall be properly adjusted and equipped with particulate filter(s).

- As before, the test subject shall breathe through his or her slightly opened mouth with tongue extended, and shall be instructed to report is he or she tastes the bitter taste of Bitrex™

- The nebulizer is inserted into the hole in front of the enclosure, and an initial concentration of the fit test solution is sprayed into the enclosure using the same number of squeezes (either 10, 20, or 30) based on the number of squeezes required to elicit taste response noted during the screening test.

- After generating the aerosol, the test subject shall be instructed to perform the test exercises provided in Appendix B.

- Every 30 seconds, the aerosol concentration shall be replenished using one half the number of squeezes used initially (such as 5, 10, or 15).

- The test subject shall indicate to the tester if at any time during the fit test the taste of Bitrex™ solution is detected. If the test subject does not report tasting the Bitrex™ solution, the test is passed.

- If the taste of Bitrex™ solution is detected, the fit is deemed unsatisfactory and the test is failed. A different respirator shall be tried, and the entire test procedure (screening and test) is repeated.

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8/10/2008	Chris McClain		Update from 1998 format
	Rick Lemmon		

APPENDIX A

RESPIRATOR USER SEAL CHECK PROCEDURES

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RESPIRATOR USER SEAL CHECK PROCEDURE

Individuals using tight-fitting respirators must perform a user seal check each time a respirator is put on to ensure that an adequate seal is achieved. Two methods are available for use; one is the positive- and negative-pressure check and the other is the respirator manufacturer's method. Either the positive- and negative-pressure checks described below may be used or, if a manufacturer of a particular respirator brand has developed its own recommended seal check method, that method may be used in place of the negative- and positive-pressure seal checks. User seal checks are not a substitute for qualitative or quantitative fit tests. The user check procedures described below are as described in the mandatory Appendix B-1 of Title 29 of the *Code of Federal Regulations*, Part 1910.134.

- Positive-Pressure Check

  Close off the exhalation valve and exhale gently into the facepiece. The face fit is considered satisfactory if a slight positive pressure can be built up inside the facepiece without any evidence of outward leakage of air at the seal. For most respirators, this method of leak testing requires the wearer to first remove the exhalation valve cover before closing off the exhalation valve and then carefully replace it after the test.

- Negative-Pressure Check

  Close off the inlet opening(s) of the canister or cartridge(s) by covering the opening with the palm of the hand(s) or by replacing the filter seal(s). Inhale gently so that the facepiece collapses slightly, and hold the breath for 10 seconds. The inlet opening of some cartridges cannot be effectively covered with the palm of the hand. In this case, the test can be performed by covering the inlet opening of the cartridge with a thin latex or nitrile glove. If the facepiece remains in its slightly collapsed condition and no inward leakage of air is detected, the tightness of the respirator is considered satisfactory.

APPENDIX B

RESPIRATOR FIT TEST EXERCISES

RESPIRATOR FIT TEST EXERCISES

Test subjects shall perform the exercises below during fit test process. Prior to the actual fit test, the test subject shall (1) select a suitable and comfortable respirator; (2) don, adjust, and then wear the respirator for 5 minutes to assess comfort; (3) conduct a user seal check in accordance with the procedures outlined in Appendix A, (4) report any difficulties breathing while wearing the respirator, (5) select a different respirator if the fit and level of comfort is unacceptable, and (6) perform the fit test exercises described below in the order listed. The qualitative fit test (QLFT) shall be performed in a test environment.

Test Exercises

Each exercise below shall be conducted for 1 minute. During testing, the subject will be questioned and observed to determine if the respirator is comfortable. The respirator shall not be adjusted during the fit testing procedure. Any adjustment voids the test, and the test must be repeated from the beginning.

1. **Normal breathing.** In a normal standing position without talking, breathe normally.
2. **Deep breathing.** In a normal standing position, breathe slowly and deeply. Be careful not to hyperventilate.
3. **Turning head from side to side.** Standing in place, slowly turn the head from side to side between the extreme positions on each side. Hold the head at each extreme momentarily and inhale at each side.
4. **Moving head up and down.** Standing in place, slowly move the head up and down. Inhale in the up position (such as when looking toward the ceiling).
5. **Talking.** Talk out loud slowly and loud enough to be heard clearly by the fit tester. Read the entire "Rainbow Passage" on the next page.
6. **Bending over.** Bend at the waist as if to touch the toes.
7. **Normal breathing.** Complete the same exercise as item 1 above.

After these test exercises are completed, the tester shall ask the test subject about the comfort of the respirator. If the respirator is uncomfortable, another respirator shall be tried and the fit test, as well as user check and screening procedures, will be repeated.

RAINBOW PASSAGE

"When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow."

Source: Appendix A of Title 29 of the *Code of Federal Regulations,* Part 1910.134

ATTACHMENT 1

ACTIVITY-BASED AIR SAMPLING FOR ASBESTOS, ERT SOP NO. 2084, REV. NO. 0.0

(29 Pages)

STANDARD OPERATING PROCEDURES

ACTIVITY-BASED AIR SAMPLING FOR ASBESTOS

CONTENTS

CONTENTS (cont'd)

1.0 SCOPE AND APPLICATION

As a result of a directive issued by the United States Environmental Protection Agency (U.S. EPA) Office of Solid Waste and Emergency Response (OSWER Directive 9345.4), estimating asbestos exposures resulting from suspension of soils is an area of increased importance to the Superfund Program. Such exposures may be estimated via monitoring and/or modeling methods. At present, models are not available to accurately estimate asbestos exposure associated with the disturbance of contaminated soil. Therefore, personal monitoring in the form of activity-based sampling (ABS) is the most appropriate technique to estimate exposure. Personal exposure is influenced by the activities performed, the duration of the activity and the site-specific soils of interest.

At a number of diverse sites across the county (Clear Creek Management Area, San Benito County, California (CA), El Dorado Schools, North Ridge Estates, Klamath Falls, Oregon, Slodusty Road, Garden Valley CA, Ambler Alaska), the U.S. EPA has demonstrated that disturbance of soil with low levels of asbestos (including soil concentrations less than 1.0 percent (%) as measured by Polarized Light Microscopy) can potentially result in significant concentrations (>0.1 structures per cubic centimeter) of respirable asbestos fibers in the breathing zone of individuals engaged in various physical activities. This may result in a cancer risk in excess of Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) remedial objectives.

Since personal monitoring is more representative of actual exposure than samples obtained from a fixed downwind location (McBride 1999, Rodes 1995, Hildemann 2005), personal monitoring results are generally most relevant to CERCLA risk characterizations. Thus the best measure of actual exposure to an individual would be through the collection of personal air samples over the exposure period of interest (NIOSH 1977). However, at CERCLA sites, it is neither always possible nor practical to do so. EPA has thus developed a sampling procedure called ABS, designed to mimic the activities of a potential receptor.

As part of ABS, U.S. EPA or contractor personnel trained in hazard recognition and mitigation, serve as surrogates for the potentially exposed populace of interest. ABS simulates routine activities in order to mimic and evaluate or predict personal exposures from disturbance of materials potentially contaminated with asbestos. Similar sampling approaches have been used to assess exposures to pesticides and lead (U.S. EPA 2000) and this technique has long been a cornerstone of industrial hygiene wherein workplace exposures are routinely assessed via personal exposure monitoring.

This document provides guidance for ABS for a particular set of activities or scenarios. Personal monitoring may be conducted during various activities such as raking, All-Terrain Vehicle (ATV) riding, rototilling, digging, a child playing in the dirt, weed whacking, lawn mowing, walking with a stroller, bicycling, and playing basketball.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

This document is not intended to be used as a substitute for a site-specific Quality Assurance Project Plan (QAPP) or a detailed Sampling and Analysis Plan (SAP). This document is intended to be used as a reference for developing site-specific QAPPs and SAPs.

Mention of trade names or commercial products does not constitute U.S. EPA endorsement or recommendation for use.

2.0 METHOD SUMMARY

There are two types of ABS that can be employed in the field: generic ABS and site-specific ABS. Generic ABS can be used with potentially contaminated soil and utilizes a rake to disturb the soil over a known area in conjunction with the collection of air samples to characterize potential exposure. Site-specific ABS is also used with contaminated soil; however, it utilizes site-specific activities to disturb the soil, such as riding ATVs, jogging or riding bikes. Although site-specific ABS provides a more realistic measure of fiber release, it can also be more resource intensive and it is recommended to be used after the generic ABS, if results deem necessary.

For all ABS events, asbestos samples should be collected from the breathing zones of the subjects at an appropriate flow rate. Special consideration should be given to characterizing exposure to children as it has been hypothesized that children are more prone to exposure than adults (U.S. EPA 2000) because they tend to be closer to the source. Sample flow rates, duration and final volume will need to be weighed against the number of grid openings that must be counted (cost factor) to obtain the needed sensitivity. Sampling periods should be of sufficient durations (averaging time) to facilitate collection of a representative sample and achieving the required level of sensitivity.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING AND STORAGE

3.1 Sample Preservation

No preservation is required for asbestos samples.

3.2 Sample Handling, Container, and Storage Procedures

1. Place a sample label on the cassette indicating a unique sampling number. Do not put sampling cassettes in shirt or coat pockets as the filter can pick up fibers or a static charge that could disturb the dust deposited on the filter media.

2. Samples must be handled gently with the filter inlet facing upward to avoid disturbing the particulate deposited on the filter and to minimize the potential of imparting a static charge to the cassette, which might alter the particulate deposition on the filter media.

3. Place the cassette individually in a manila-type envelope. Each envelope should be marked with the sample identification number, total volume, and date.

4. To the best extent possible, the sampling cassettes in the manila envelopes should be placed right side up so that the cassette inlet cap is on top and cassette base is on bottom. Place samples into a shipping container and use enough packing material to prevent jostling or damage. Samples must be handled gently so as not to disturb the dust deposited on the filter media. Do not use vermiculite or any other type of fibrous packing material for samples. If possible, hand carry to lab.

5. Provide appropriate documentation with samples (i.e., chain of custody and requested analytical methodology).

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

4.1 Area Selection

When selecting areas for ABS, consideration should be given to the potential for off-site migration of contaminants and possible exposure of the public. Within the constraints of ABS, to the degree practical, particulate generation migration off-site should be minimized, and constraints or mitigation protocols established to eliminate public exposure. These constraints/mitigation protocols may include conducting the ABS in remote areas of the site, dust suppression using water mist, building a containment structure, etc. Air sampling should be conducted to document the airborne concentration of asbestos at the site perimeter during activities.

4.2 Flow Rate Considerations

For activities that generate a large quantity of dust (i.e., particulates), sample flow rates may need to be reduced accordingly to avoid overloading the filters. For example, a sampling pump flow rate of approximately 3.0 liters per minute (L/min) was found most effective at one site for monitoring for asbestos while riding ATVs on dusty soils while high soil moisture and reduced particulate generation at another site permitted a 5.0 L/min flow rate.

High flow rates may result in filter damage due to failure of its physical support associated with increased pressure drop, leakage of air around the filter mount so that the filter is bypassed or damage to the asbestos structures (breakup of bundles and clusters) due to increased impact velocities (ISO 10312). High flow rates can also tear the filters during initial pump startup due to the shock load placed on the filter when the pump is first started.

Sampling larger volumes of air and analyzing greater areas of the filter media can theoretically lower the limit of detection indefinitely. In practice, the total suspended particulate (TSP) concentration limits the volume of air that can be filtered as TSP can obscure asbestos fibers. The International Organization for Standardization (ISO) Method 10312 states that the direct analytical method cannot be used if the general particulate loading exceeds approximately 10% coverage of the collection filter. An airborne concentration of approximately 10 micrograms per cubic meter

($\mu g/m^3$), corresponding to clean rural air, results in approximately 10% coverage of the filter media based on a 4000-L sample.

The following formula from ISO 10132 may be used to calculate the analytical sensitivity:

$$S = \frac{A_t}{KA_gV}$$

Where:

S = Analytical sensitivity expressed in structures per liter

A_t = Active area in square millimeters of the collection media or filter

A_g = Mean area in square millimeters (mm^2) of the grid openings examined,

K = Number of grid openings examined

V = Volume of air sampled, in liters

NOTE: 25-millimeter (mm) cassettes have an effective filter area of 385 mm^2 and 37-mm cassettes have an effective filter area of 855 mm^2. The typical grid opening is 0.0057 mm^2. Note: Grid size will vary between laboratories and dimensions should be verified prior to calculating the number of grid openings that must be counted to achieve a particular level of sensitivity.

Table 1 provides an example of the minimum number of grid openings that must be counted in order to achieve various sensitivity and detection limits.

It is frequently more efficient to employ co-located samplers to collect a high and low volume of air. This increases the likelihood of at least one of the two samples being readable using the direct analytical method (ISO 10312) than to lose the sample due to overloading or having to analyze by the indirect method (ISO 13794).

4.3 Transmission Electron Microscopy (TEM) Specimen Preparation Methods

It can be argued that direct methods yield an under-estimate of the asbestos structure concentration because other particulate material with which they are associated conceals many of the asbestos fibers present. Conversely, indirect methods can be considered to yield an over-estimate because some types of complex asbestos structures disintegrate during the preparation, resulting in an increase in the numbers of structures counted.

4.3.1 Direct-Transfer TEM Specimen Preparation Methods

Direct-transfer preparation methods are intended to retain all particles in the same relative positions with respect to each other on the final TEM grids as on the original filter. The membrane filter, or a portion of it, is placed on a microscope slide with the sample face upward, and then collapsed by exposure to acetone vapor. The cleared filter is then etched in a low-temperature plasma asher, subsequently coated with carbon in a sputtering device and then peeled from the glass slide. A portion of the collapsed, etched and carbon-coated filter is then transferred to an electron microscope grid and then extracted with dimethylformamide, glacial acetic acid and water to remove the filter. Once the process is complete, the particles originally collected on the filter are bound in the carbon film and the grids can be observed on a transmission electron microscope (ISO 1995). Direct-transfer TEM specimen preparation methods have the following significant interferences:

- The particulate density on the filter, which in turn is controlled by the sampled air volume and the total suspended particulate concentration in the atmosphere being sampled, restricts the achievable detection limit.

- The precision of the result is dependent on the uniformity of the deposit of asbestos structures on the sample collection filter.

- Air samples must be collected so that they have particulate and fiber loadings within narrow ranges. If too high a particulate loading occurs on the filter, it is not possible to prepare satisfactory TEM specimens by a direct-transfer method. If too high a fiber loading occurs on the filter, even if satisfactory TEM specimens can be prepared, accurate fiber counting may not be possible.

4.3.2 Indirect TEM Specimen Preparation Methods

In the indirect preparation method the membrane filter, or a portion thereof, is placed on a microscope slide, sample face downward, and ashed in a low temperature asher until complete calcination of the filter is achieved. The ash is then recovered in distilled water and the solution then filtered on a polycarbonate filter. The indirect transfer method re-distributes the particulate on a new membrane filter.

Indirect TEM specimen preparation methods have the following interferences:

- The size distribution of asbestos structures is modified (clusters, matrices bundles, etc. may be broken up during sample preparation).

- There is increased opportunity for fiber loss or introduction of extraneous contamination from laboratory glassware, process water, etc.

- When sample collection filters are ashed, any fiber contamination in the filter medium is concentrated on the TEM specimen grid.

The direct analytical method (ISO 10312) is the preferred method and every reasonable effort should be made to prevent overloading of the filter, which would necessitate use of the indirect method. Samples that are overloaded may, at the discretion of the project management team, be analyzed by ISO Method 13794 "Ambient air – Determination of asbestos fibres – Indirect-transfer transmission electron microscopy method" (ISO 1999). Results of the ISO 13794 analysis should be reviewed discrete of the ISO 10312 samples and a decision made regarding combining the two data sets.

4.4 Sampling Cassette Orientation

Air sampling cassettes must be oriented with the open face pointing down to preclude large non-respirable particles from falling or settling onto the filter media.

5.0 EQUIPMENT/APPARATUS

- Personal sampling pumps, providing a flow rate from 0.020 L/min up to 4.0 L/min, battery powered
- High flow sampling pumps (i.e., Quik Take 30 or AirCon II), capable of providing a flow rate from 4.0 to 12 L/min, battery or alternating current (AC)
- Mixed cellulose ester (MCE) filter cassettes, 0.45 or 0.8 micrometer (µm), 25-mm diameter, purchased from a certified vendor with appropriate documentation (low filter background counts, consistent filter area, certified leak-free cassettes)
- Sampling setups, Tygon® tubing with Luer type adaptor
- Backpacks
- Sampling stands, for perimeter sampling
- Duct tape
- Tools, miscellaneous (e.g., screwdrivers, pliers, cutting tool, etc.)
- Envelopes, manila-type
- Whirlpak® bags
- Sample labels

- Chain of custody (COC) records
- Logbook and/or sampling worksheets
- Precision rotameter or primary flow standard appropriate for sampling flow rate
- Personal protective equipment (PPE), including but not limited to respirators, boots, gloves, eye protection, hard hat, to be determined based on type of activity and possible exposure
- Decon equipment (Plastic sheeting, liquinox®, buckets, brushes, water, Hudson sprayers, garbage bags, etc.)
- Power sources, e.g., line power, solar recharging batteries, power inverters, generators, etc.

6.0 REAGENTS

Reagents are not required for the preservation of asbestos samples.

7.0 PROCEDURES

7.1 Pre-Site Sampling Preparation

1. Determine the extent of the sampling effort (number of locations, repetitions, number of samples, etc.), the sampling methods to be employed, and the types and amounts of equipment and supplies needed.
2. Obtain necessary sampling equipment and ensure it is in working order and fully charged (if necessary).
3. Perform a general site survey prior to site entry in accordance with the site-specific Health and Safety Plan (HASP).
4. Once on-site the calibration is performed in the clean zone. The calibration procedures are listed in Section 7.2.
5. After calibrating the sampling pump, mobilize to the sampling location.

7.2 Calibration Procedures

To determine if a sampling pump is measuring the flow rate or volume of air correctly, it is necessary to calibrate the equipment. Sampling pumps should be calibrated on a routine basis and prior to use.

A rotameter can be used provided it has been calibrated with a primary calibrator. Typically rotameters are calibrated on a yearly basis. Sampling pumps can be calibrated prior to coming on-site in order to expedite on-site calibration. However, calibration must be verified on-site prior to use.

7.2.1 Calibrating a Personal Sampling Pump with a Rotameter

1. Refer to the manufacturer's manual for the Rotameter Operational Instructions.

2. Set up the calibration train using a rotameter, sampling pump and the sampling cassette that will be used during the sampling event. This train may be set up prior to field mobilization and will be checked in the field again prior to use.

3. To set up the calibration train, attach one end of the polyvinyl chloride (PVC) tubing (approx. 2 ft) to the cassette base; attach the other end of the tubing to the inlet plug on the pump. Another piece of tubing is attached from the cassette cap to the rotameter. Insure that the tubing and rotameter used to calibrate the pump do not restrict the airflow.

4. Assemble the base of the flow meter with the screw provided and tighten in place. The flow meter should be mounted within 6 degrees (^{o}) of vertical (Omega 1987).

5. Turn the sampling pump on.

6. Turn the flow adjust screw (or knob) on the personal sampling pump until the float ball on the rotameter is lined up with the pre-calibrated flow rate value on the rotameter. Note: rotameters should be marked with the previous calibration date and corresponding flow rates and scale.

7. A verification of calibration is generally performed on-site in the clean zone immediately prior to the sampling.

7.2.2 Calibrating a Personal Sampling Pump with an Electronic Calibrator

1. Refer to the manufacturer's manual for operational instructions.

2. Set up the calibration train using a sampling pump, electronic calibrator, and the actual sampling cassette or a representative filter cassette. The same lot of cassettes used for sampling should also be used for calibration.

3. To set up the calibration train, attach one end of the PVC tubing (approx. 2 foot) to the cassette base; attach the other end of the tubing to the inlet plug on the pump. Another piece of tubing is attached from the cassette cap to the electronic calibrator.

4. Turn the electronic calibrator and sampling pump on. Select a flow rate to calibrate.

5. Turn the flow-adjust screw or knob on the pump until the desired flow rate is attained on the rotameter.

6. Using the primary calibrator, obtain approximately 10 readings three times until the flow rate of ± 5% of the required flow is attained.

7.3. Meteorology

It is recommended that an onsite, portable, 3-meter meteorological station be established. If possible, sample after two to three days of dry weather and when wind conditions are representative for the climatology of the location based on month and time of day. Historical hourly wind speed and wind direction data should be analyzed before mobilization. Wind speed, wind direction, temperature, and station pressure should be recorded on the meteorological station data logger and real-time data should be available for review on the station display panel. Suggested meteorological station specifications can be found in Table 2, Appendix A or ERT SOP #2129, *Met One Remote Meteorological Station.* Alternatively, a nearby representative meteorological station, as determined by a meteorologist, may be used to acquire the necessary data.

7.4 General Sampling Information

For all activity-based sampling events, except as noted otherwise, asbestos samples will be collected from the breathing zones of the event participants. The breathing zone can be visualized as a hemisphere approximately 6 to 9 inches around an individual's face. Breathing zone samples provide the best approximation of the concentration of contaminants in the air that an individual is actually breathing. Specific breathing zone heights should be determined on a project-by-project basis based on the anthropometrics for the study population and the participants' positions during the performance of each task.

If it is necessary to relieve a participant from the activity, another sample collector should be suited and ready to participate in the ABS prior to the personnel exchange. The participant will stop the activity, remove the backpack or belt, and pass it to the relief participant similar to the transfer of a baton in a relay race. The original participant will assist the relief participant with donning and adjusting the backpack or belt. The exchange is anticipated to take less than 60 seconds, therefore the sampling pumps and event time clock will not be halted during the exchange. If the exchange requires more than 60 seconds, the pump and event clock will be stopped until activity is re-initiated.

Sample volumes and detection/quantification limits should be specified in the site-specific QAPP with flow rates and sampling periods adjusted accordingly. Typical sensitivity limits that have been employed for risk assessment have been approximately 0.001 S/cc for ABS samples and 0.0001 S/cc for background or reference samples. Based on ISO 10312 Table 1, a sensitivity limit of 0.001 S/cc would require a sample volume of greater than 500 liters to keep the number of grid openings to be counted below 100. Similarly, a sample volume greater than 5000 L would be required to reach 0.0001 S/cc and count fewer than 100 grid openings. For all asbestos sampling, an asbestos sampling train consisting of 0.8-µm, 25-mm mixed cellulose ester (MCE) filter connected to a personal sampling pump will be used. The top cover from the cowl extension on the sampling cassette shall be removed ("open-face") and the cassette oriented face down for all asbestos filters. All samples should be collected open-faced unless a specific requirement for sampling closed-faced exists.

For activity based sampling, a personal sampling pump (or equivalent) or SKC Quick Take 30 will be calibrated to collect between 2 and 12 L/min of air through the filter depending on the capacity of the pump. The flow rate will be based upon the duration of time required to collect a minimum target volume of 560 L and provide a sensitivity limit of 0.001 S/cc.

Generally each activity based sampling event should be repeated a minimum of three times in an area to expose trends. This can be accomplished by a single participant repeating the activity three or more times or by having a single simulation with three or more participants. If soil moisture or seasonal variability is a concern, then three events for each different season or meteorological conditions may be appropriate.

The sampling pumps used should provide non-fluctuating airflows through the filter, and should maintain the initial volume flow rate to within ± 10% throughout the sampling period. A constant flow or critical orifice controlled pump typically meets these requirements. If the flow rate changes by more than 5% during the sampling period, the average of the pre- and post-sampling rates will be used to calculate the total sample volume. If at any time the measurement indicates that the flow-rate has decreased by more than 30%, sampling should be terminated. Depending on the type of sampling pump used, it may be possible to salvage the sample if sufficient volume was collected; however, it may not be representative of the time it takes for the actual activity to be completed. Depending on the type of sampling pump used, the actual sampling time in hours and minutes before the sampling fault may be displayed and an actual sample volume calculated. If the fault was due to battery failure, it may be possible to check the post-sampling flow.

During certain ABS activities, participants may be fitted with two sampling pumps to collect a high-flow or volume and a low-flow or volume sample. Co-located samples are collected to sample a high and low volume of air to increase the likelihood of at least one of the two samples being readable using the direct analytical method (ISO 10312). Approximately 560 L (40 CFR 763) is collected for the low-flow samples and up to 4000 L for the high-flow samples. The targeted high volume is typically 1200 L, which permits counting approximately 54 grid openings for a sensitivity level of 0.001 S/cc.

7.5 Generic Activity-Based Sampling Scenario / Raking

The raking scenario, also referred to as the generic scenario, is appropriate for all sites with soils potentially contaminated with asbestos. Generic ABS should be employed in a grid pattern to evaluate the potential for fiber release from soil over a portion of the site. If the analytical results are above the criteria that were derived for the site, then remediation or institutional controls should be implemented or additional site-specific ABS should be undertaken. If the analytical results are below the criteria that were derived, then no further action may be necessary.

In this activity or simulation a participant will rake a lawn or garden area to remove debris such as rocks, leaves, thatch and weeds using a leaf rake with a rake width of approximately 20 to 28 inches. Participants should strive to disturb the top half-inch of soil with an aggressive raking motion. This depth will vary based on the objective of the scenario.

Each raking participant donning appropriate PPE will be fitted with a personal sampling pump contained in a backpack with the cassette secured to the shoulder straps near the operator's lapels in the breathing zone. Personnel will rake a lawn or garden area to remove debris for a minimum of 1 to 2 hours (flow rate and sensitivity level dependent). Raking will occur in a measured area with vegetation, soil or rocks/gravel and will occur in an arched motion raking from the left of the participant to the right. The participants will rake the debris towards themselves facing one side of the square for 15 minutes then the participant will turn 90 degrees clockwise and begin a new side. Participants will continue to rake each side of the square and rotate 90 degrees. Once several small piles of debris have been made, the participant shall pick up the debris and place it in a trashcan. The sequence of raking, rotating and picking up debris shall be repeated for the duration of the sampling period. The participant should stay in the same plot for the entire sampling period.

7.6 Site-Specific Activity-Based Sampling Scenarios

If site-specific ABS is undertaken, the number and types of activities as well as the types of scenarios should be based on current and potential land use. Reference to current and currently planned future land use and the effectiveness of institutional or legal controls placed on the future use of the land should be evaluated. Probable land use should be selected based on zoning and the existing land use of the site and adjacent areas.

Land use assumptions should be based on a factual understanding of site-specific conditions and reasonably anticipated use. The land use evaluated for the assessment should be based on a residential exposure scenario (i.e., the default worst-case) unless residential land use is not plausible for the site. Future land use assumptions should be consistent with reasonably anticipated future land use based on input from planning boards, appropriate officials, and the public.

7.6.1 ATV Riding

This scenario might be appropriate for recreational areas or other areas where ATVs are typically ridden where asbestos contamination is present. This activity is designed to be representative of two or more ATV participants riding on a course or trail. Riders should maintain their relative position (lead, middle, tail) throughout the activity.

Each ATV rider wearing appropriate PPE will be fitted with two personal sampling pumps set at two distinct flow rates, to collect approximately 560 and 1200 liters of air, because of filter overloading concerns. The cassettes for the personal sampling pumps will be attached to the shoulder straps of the backpack proximal to the riders' lapels in the breathing zone. It may be beneficial to attach a dust monitor (e.g., DataRAM) to the tail ATV to record dust levels and gauge dust loading. The sampling pumps will be carried in a backpack while the dust monitor, if used, will be mounted to the ATV.

Personnel will ride the ATVs around a course at the same time until a sufficient volume of air has been collected to achieve the required sensitivity limit of 0.001 S/cc of air. The riders, one lead rider and one following rider, will vary the vehicle speed between 5 and 30 miles per hour (mph). Riders will strive for an average speed of 10 mph. The average speed is a target speed only; vehicle speeds will be adjusted to meet track conditions. Vehicles will be equipped with a speedometer and odometer to record speeds and distance traveled. ATV riding and sampling should be conducted for 30 to 120 minutes in duration, depending on dust loading and required detection limits.

ATVs and ATV tires should be selected as appropriate for the area being studied. Specifically, the size (i.e., weight, horsepower, etc.) of the ATV should be appropriate for the study area. The vehicle tires should have a tread pattern that is representative of those typically used in the area. Local ATV shops or ATV clubs should be consulted for guidance.

7.6.2 Child Playing in the Dirt

This scenario might be appropriate for sites where schools, playgrounds, parks or residential areas, etc. are contaminated with asbestos; the overarching criteria being areas where a child might be expected to play or dig in the dirt. This scenario was designed to be representative of a child playing in the dirt with a shovel and pail.

The event participant wearing appropriate PPE will be fitted with a personal sampling pump; the inlet to the filter will be at a height of approximately 1 to 3 feet above the ground to simulate a child's breathing zone. The actual pump unit should be secured in a backpack or on a belt.

A participant should sit on the ground while digging or scraping the top 2 to 6 inches of surface soil, placing it in a small bucket or pail and dumping it back on the ground. The activity will be paced such that soil will be placed in the bucket and dumped approximately every two to five minutes, regardless of the amount of material in the bucket. The bucket should be emptied rapidly from a height of approximately 12 inches, based on observations of two to four-year-olds playing in a sandbox.

A sampling period and flow rate to collect a sufficient volume of air will be determined as to achieve the project-specific detection/quantification limit. The sampling period will be divided into equal sub-periods to facilitate having the participant face each compass direction for an equal amount of time during the activity. This approach is designed to mitigate the effect of wind direction on potential exposure. Random head and body movement during the activity should further mitigate the impact of wind direction on exposure. Ideally, the participants will face each compass direction at least twice during the sampling event. For example, during a two-hour or 120-minute event, the participant might face North for 15 minutes, rotate to the East for 15 minutes, then South for 15 minutes, then West for 15 minutes and return to the North to repeat the cycle. Participants should move to a fresh patch of soil after the completion of each cycle (360 degree rotation).

7.6.3 Gardening/Rototilling

This scenario might be appropriate for sites where gardening or surface disturbance to a depth of approximately one foot is anticipated. This activity is designed to be representative of individuals participating in gardening activities using a rototiller.

Each rototilling participant donning appropriate PPE will be fitted with a personal sampling pump. The actual pump unit will be contained in a backpack with the cassette secured to the shoulder straps near the operator's lapels in the breathing zone.

Personnel will operate a rototiller for a minimum of two hours to loosen soil in the yard to a depth of approximately 12 inches. The depth chosen is area-specific and will need to be determined on a case-by-case basis. A rear tine rototiller in the six to eight horsepower range will be selected. Other types or sizes of tillers may be appropriate based on the soil conditions and type of gardening being conducted.

A 100 to 720-square-foot plot of land will be selected to till. The average size of a community garden in New Jersey was 720 square feet based on a survey conducted by Rutgers University in 1991 (Patel 1991). The edges will be delineated. Square plots are preferred. The rototiller operator will conduct typical associated activities such as removing rocks and debris from the tilled area. To account for the effects of varying wind direction on potential exposure, the operator will till the soil back and forth towards each side of the square continuously for 10 minutes, shut down the machine or place it in neutral, and rake or sort through the material for five minutes. The operator will then turn 90 degrees in a clockwise direction and repeat the previous 15-minute procedure. The operator will continue to rotate 90 degrees clockwise every 15 minutes until the two-hour sampling period is complete. The participant should stay in the same plot for the entire sampling period.

7.6.4 Weed Whacking/Cutting

This scenario might be appropriate for sites where lawn maintenance might be conducted such as in residential and commercial areas. This activity is designed to simulate a person trimming weeds and grasses.

Each weed-whacking participant will be fitted with a personal sampling pump. The actual pump unit will be contained in a backpack with the cassette secured to the shoulder straps near the operator's lapels in the breathing zone. Personnel wearing appropriate PPE will operate a gas or electric-powered string trimmer. A 25 to 35-cc gas or electric-powered trimmer with a 16 to 18- inch cutting swath will be selected. Trimming and edging will occur in a measured area with thick vegetation (typically 100 to 720-square feet, based on a typical residential garden) (Patel 1991). Trimming will be done using a side to side sweeping motion with the operator moving in a series of straight lines back and forth towards one side of the selected area for 10 minutes, resting five minutes, and turning 90 degrees in a clockwise direction before repeating this 15-minute procedure for the duration of the sampling period. The participant should stay in the same plot for the entire sampling period.

7.6.5 Digging

Digging might be appropriate for sites where construction projects are likely to occur or where plants might be planted. Digging will occur in a measured area with vegetation, soil or rocks/gravel.

Each digger participant donning appropriate PPE will be fitted with a personal sampling pump contained in a backpack with the cassette secured to the shoulder straps near the operator's lapels in the breathing zone. The participants will dig a hole to approximately two feet deep and two feet (representative of planting a small shrub or digging a fencepost; site-specific dimensions should be specified in the QAPP/SAP) in diameter (Vodak 2004) and will place the soil next to the hole. The participants will then refill the hole with the soil that had been removed. Participants will then rotate 90 degrees in a clockwise direction and continue to dig and refill additional holes until the sampling period is complete. The sequence of digging, filling and rotating shall be repeated for the duration of the sampling period.

7.6.6 Lawn Mowing

Lawn mowing might be appropriate for sites where lawn maintenance might be conducted such as residential and commercial areas.

Each lawn-mowing participant will be fitted with a personal sampling pump contained in a backpack with the cassette secured to the shoulder straps near the operator's lapels in the breathing zone. Personnel wearing appropriate PPE will operate a gas-powered lawn mower. Mowing will occur in a measured area with thick vegetation and will occur in a shrinking square pattern. Participants will divide the area into a number of squares that decrease in size towards the center of the square by the width of the mower swath. Mower blades will be set at approximately 2 to 2.5 inches. A bag-less side discharge 3- to 5-horsepower lawn mower will be used for this exercise.

7.6.7 Walker with Stroller

This scenario might be appropriate for sites such as parks, paths or open-space. The actual pump unit will be secured in a backpack. The cassette for the personal sampling pump will be attached to the shoulder straps of the backpack proximal to the walker's lapel in the breathing zone. A second pump will be placed in the stroller at a child's breathing zone height.

During these events, walkers wearing appropriate PPE pushing a stroller will walk back and forth along a portion of a path until a sufficient volume of air has been collected to achieve the required detection limit. The walkers will vary their speed between 1.5 and 4 mph. Walkers will strive for an average speed of 2 mph. The average speed is a target speed only; speeds will be adjusted to meet trail conditions. Walkers should be equipped with a global positioning system (GPS) unit to estimate average speed and distance traveled.

7.6.8 Jogging

This scenario might be appropriate for sites such as parks, paths or open-space. The actual pump unit will be secured in a backpack. The cassette for the personal sampling pump will be attached to the shoulder straps of the backpack proximal to the jogger's lapel in the breathing zone.

During these events, joggers wearing appropriate PPE will run/jog back and forth along a portion of a path until a sufficient volume of air has been collected to achieve the required detection limit. The joggers will vary their speed between 2.5 and 5 mph. Joggers will strive for an average speed of 4 mph. The average speed is a target speed only; speeds will be adjusted to meet trail conditions. Joggers should be equipped with a GPS unit to estimate average speed and distance traveled.

Two or more joggers can participate in this activity. When multiple joggers participate, they should maintain their relative position throughout the event (lead, middle, tail). Joggers should be spaced five feet apart.

7.6.9 Two Bicycles

Bicycling might be appropriate for sites such as parks, paths or open-space. Two bicyclists wearing appropriate PPE will ride back and forth with one leading and one following along the length of the site portion of a path or ride around a site (no trail) until a sufficient volume of air has been collected to achieve the required detection limit.

The bicycling participants will each be fitted with personal sampling pumps. The actual pump units will be contained in backpacks with the cassettes secured to the shoulder straps near the cyclists' lapels in the breathing zone.

During these events, the bicycle riders will vary their speed between 3 and 15 mph. Riders will strive for an average speed of 8 mph. The average speed is a target speed only; bicycle speeds will be adjusted to meet trail conditions. Bicycles will be equipped with a GPS to estimate average speed and distance traveled. Riders should maintain their relative position (lead, tail) throughout the activity.

7.6.10 Basketball Scenario

This scenario might be appropriate for sites where basketball courts are present. The basketball scenario was developed to simulate a group of recreational basketball players gathering to play a casual game of basketball for 120 minutes on an outdoor concrete or macadam court. Between four and 10 players wearing appropriate PPE can participate in this exercise.

- From 0 to 15 minutes, two of the players will sweep court with push brooms from the perimeter of the court to the center. While these two people are sweeping the court, the remaining personnel should mill about under the basket and take a few shots.

- From 15 to 30 minutes, shot practice participants stand around the key as for a free throw, with the exception that one of the participants is positioned under the basket to retrieve the ball after each shot. The player closest to the basket on the left side (facing the basket) takes two shots and the ball/shooter rotates counter clockwise after those two shots. Each person shoots consecutively until everyone has taken two shots. The entire group then rotates clockwise. This sequence should be repeated until time expires. Ideally, each player should shoot from each key position and take a turn retrieving the ball under the basket.

- From 30 to 45 minutes, each player takes turns practicing lay-ups. All players line up on the left side of the basket (facing the basket) and shoot one after another. The first person shoots then retrieves the ball for next person in line and so on. Players should use two basketballs with the second person bouncing the ball outside of the key as the first person shoots. Players should run a full cycle from left then a full cycle from right; repeating the left, right cycles until the interval time is up.

- From 45 to 60 minutes, shot practice as described in the 15 to 30 minute interval above will be conducted.

- From 60 to 75 minutes, a half-court game will be played to the degree practical.

- From 75 to 100 minutes, shot practice as described in the 15 to 30-minute interval above will be conducted.

- From 100 to 120 minutes, a lay-up drill as described in the 30 to 45 minute interval above will be conducted.

7.7 Cumulative Exposure Scenario

A cumulative exposure study might be appropriate for sites where individuals move about a site during the course of a day, with varying levels of exposure at multiple indoor and outdoor locations. The objective is to estimate aggregate and cumulative exposure to asbestos over the course of a day. Cumulative exposure studies should be conducted in order to increase understanding of linkages between sources of asbestos and subsequent exposure and dose to humans for use in mitigating risk and reducing exposure and disease.

Over periods of weeks, years or decades, exposures to environmental agents such as asbestos occur intermittently rather than continuously. Yet long-term health effects, such as cancer, are routinely projected based on an average dose over the period of interest (typically years), rather than as a series of intermittent exposures. Consequently, long-term doses are usually estimated by summing doses across discrete exposure episodes and then calculating an average dose for the period of interest (e.g., year, lifetime).

For the cumulative exposure studies, representative members of the population of interest should be selected for 24 hour sampling. The volunteers should be instructed to go about their day as usual. That is, they should not modify their schedule or activities just because they will be wearing a sampling pump.

A minimal description of exposure for a particular route must include exposure concentration and the duration. This is the method of choice to describe and estimate short-term doses, where integration times are of the order of minutes, hours or days. When projecting long term exposures, on the order of years or a lifetime, since it is typically impractical to sample for the entire exposure period, short-term exposure estimates are assumed to be representative of long-term periods and are integrated to estimate long-term exposures, typically with a safety factor to account for variability.

Observations of activities should be recorded throughout each cumulative exposure study, together with the other relevant factors including locations and activities during the study.

Samples will be collected using a personal air pump with a flow rate of approximately 3.5 L/min. Samples shall be collected open-faced with the inlet facing downward at a personal breathing zone height of 4 to 6 feet for 24 hours. Because the battery life for a personal monitor is typically eight to10 hours, the pump shall be changed out at approximately 8-hour intervals (keeping the same filter cassette). Each pump shall be pre-calibrated to 3.5 L/min prior to use. Each monitor shall be worn at normal breathing height during all waking hours. During sleep, the monitor will be placed in the same room as the sleeping individual. The sampling cassette will be placed proximal to the breathing zone of the reclined participant.

Should a study subject participate in a high dust generating activity such as riding an ATV, the 24 hour sampling cassette event should be paused and a short term exposure sample should be collected on a separate cassette with an appropriately calibrated sampling pump. Once the high dust activity has been terminated, the original 24-hour cassette and pump should be resumed for the remainder of the sampling period. Results of the 2 or more samples, depending on the number of high dust generating events should be summed to derive the total 24-hour exposure data.

7.8 Background/Reference Sampling

Background/reference samples should be collected for all sampling events. A background or reference sample is defined as a sample collected upwind at a distance sufficient to prevent being influenced by the simulated activities and outside the site perimeter. To the degree practical, the area selected for background or reference sampling should be free of known asbestos contamination. The background level should reflect the concentration of asbestos in air for the environmental setting on or near a site or activity location and can be used to evaluate whether or not a release from the site or activity has occurred. Background level does not necessarily represent pre-release conditions or conditions in the absence of influence from source at the site. A background level may or may not be less than the detection limit, but if it is greater than the detection limit, it should account for variability in local concentrations. Background or reference samples should be collected concurrent with ABS using stationary sampling pumps. Sampling and analytical parameters (sample volume grid opening count, etc.) should be prescribed to permit a detection limit approximately an order of magnitude below that of the ABS detection limit.

An Aircon II sampling pump (or equivalent) will be calibrated to collect 10 L/min for on-site and off-site air samples through the filter. The flow rate will allow a minimum target volume of 4000 L and will provide a sensitivity limit of 0.0001 S/cc. Lower volume air samples will be collected concurrently at the ambient air sampling locations. Personal sampling pumps will be utilized in the same manner with the same media at a flow rate between 2- and 3- L/min in order to collect a sample volume of approximately 1000 L. The target sensitivity of these samples is also 0.0001 S/cc when additional grids are counted in accordance with the method. Co-located samples are collected to sample a high and low volume of air to increase the likelihood of at least one of the two samples being readable using the direct analytical method (ISO 10312).

7.9 Perimeter Sampling

Perimeter samples are defined as samples collected upwind, downwind or crosswind of a specific activity. When selecting areas for ABS, consideration should be given to the potential for off-site migration of contaminants and possible exposure of the public. Within the constraints of ABS, to the degree practical, particulate generation migration off-site should be minimized, and constraints or mitigation protocols established to eliminate public exposure. These constraints/mitigation protocols may include conducting the ABS in remote areas of the site, dust suppression using water mist, building a containment structure, etc. Air sampling should be conducted to document the airborne concentration of asbestos at the site perimeter during activities. Perimeter air monitoring should be conducted to:

- Document air quality during ABS and establish background or upwind levels of asbestos during site activities
- Monitor and document air quality during site activities near sensitive receptors
- Provide risk management information and address public confidence
- Reduce possible liabilities associated with ABS

Perimeter air sampling should be performed to ensure that ABS activities do not result in excessive airborne asbestos emissions from the site. Air samples should be collected and analyzed to determine the concentrations of asbestos at the site perimeter.

An Aircon II sampling pump (or equivalent) will be calibrated to collect 10 L/min for on-site and off-site air samples through the filter. The flow rate will allow a target volume of 4000 L and will provide a sensitivity limit of 0.0001 S/cc. Lower volume air samples will be collected concurrently at the perimeter sampling locations using personal sampling pumps, if loading is an issue. These pumps will be utilized in the same manner with the same media at a flow rate between 2- and 3-L/min in order to collect a sample volume of approximately 1000 L. The target sensitivity of these samples is also 0.0001 S/cc when additional grids are counted in accordance with the method. Co-located samples are collected to sample a high and low volume of air to increase the likelihood of at least one of the two samples being readable using the direct analytical method (ISO 10312).

7.10 Soil Sampling

A sufficient number of soil samples should be collected to characterize the study area. Since particulates are expected to be released from the entire study area, the primary objective of the soil sampling is to estimate the populations mean concentration. Composite samples are appropriate for characterizing study areas and a sampling design program such as Visual Sampling Plan is recommended for calculating the number and location of samples with the appropriate confidence intervals. Soil sampling should be conducted in accordance with ERT SOP #2012, *Soil Sampling.*

Soil characteristics should be documented in conjunction with the activity-based personal exposure monitoring using American Society of Testing and Materials (ASTM), Method D2488 - 00: *Description and Identification of Soils (Visual-Manual Procedure)*, soil moisture by ASTM Method D2216-05: *Standard Test Methods for Laboratory Determination of Water (Moisture)*

Content of Soil and Rock by Mass and grain size by ASTM Method D6913-04e1: *Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis* or Method D422-63 (2002): *Standard Test Method for Particle-Size Analysis of Soils.*

Soil samples should be representative of the soil. Table 3 provides examples of soil sampling depths, which may be disturbed by the activity being performed.

The relationship between the concentration of asbestos in a source material (typically soil) and the concentration of fibers in air that results when the source is disturbed is very complex, depending on a wide range of variables. To date, no method has been found that reliably predicts the concentration of asbestos in air given the concentration of asbestos in the source. Because of this limitation, this SOP emphasizes an empiric approach, where concentrations of asbestos in air at the location of a source disturbance are measured rather than predicted.

8.0 CALCULATIONS

The sample volume is calculated from the average flow rate of the pump multiplied by the number of minutes the pump was running (volume = flow rate X time in minutes). The sample volume should be submitted to the laboratory and identified on the chain of custody for each sample (zero for lot, and field blanks).

The concentration result is calculated by dividing the number of asbestos structures reported after the application of the cluster and matrix counting criteria by the sample volume (concentration = number of asbestos structures / sample volume).

9.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

The following general QA procedures apply:

1. All data must be documented on field data sheets or within site logbooks. Record the following: date, time, location, sample identification number, pump number, flow rate, and cumulative time.

2. All instruments/equipment must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented.

3. Field blanks should be collected at a rate of one per twenty samples or one per sampling event, whichever is greater

4. Lot blanks should be collected at a rate of at least two per lot

5. Collocated samples should be collected at the frequency of one per sampling event

For TEM analysis, the following QC procedures apply:

1. Examine lot blanks to determine the background asbestos structure concentration.

2. Examine field blanks to determine whether there is contamination by extraneous asbestos structures during specimen preparation or handling.

3. Examine laboratory blanks to determine if contamination is being introduced during critical phases of the laboratory program.

4. To determine if the laboratory can satisfactorily analyze samples of known asbestos structure concentrations, reference filters shall be examined. Reference filters should be maintained as part of the laboratory's Quality Assurance program.

5. To minimize subjective effects, some specimens should be recounted by a different microscopist.

6. Asbestos laboratories shall be accredited by the National Voluntary Laboratory Accreditation Program.

7. At this time, performance evaluation samples for asbestos in air are not commonly available for Removal Program Activities; however, they should be considered on a case-by-case basis.

10.0 DATA VALIDATION

Results of QC samples will be evaluated for contamination. This information will be utilized to qualify the environmental sample results accordingly with the project's data quality objectives.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA, and corporate health and safety procedures. More specifically, when entering an unknown situation involving asbestos, a powered air-purifying respirator (PAPR) (full face-piece) is necessary in conjunction with high-efficiency particulate air (HEPA) filter cartridges. See applicable regulations for action levels, permissible exposure levels (PEL) and threshold limit values (TLV). If previous sampling indicates asbestos concentrations are below personal health and safety levels, then Level D personal protection is adequate.

For all ABS, appropriate PPE, including Tyvek coveralls, protective gloves and foot wear, and a respirator with HEPA filter cartridges (P-100 or equivalent) should be worn to protect participants. Details regarding PPE and other protective measures should be specified in the site-specific Health and Safety Plan. Special consideration should be given to the physical safety of the event participants as well as heat stress associated with performing vigorous activities in impermeable clothing.

12.0 REFERENCES

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13.0 APPENDICES

TABLE 1. Minimum Number of Grid Openings Required To Be Counted to Achieve a Given Analytical Sensitivity and Detection Limit. (Adapted from ISO 10312)

TABLE 2. Suggested Meteorological Station Specifications

TABLE 3. Soil Sampling Depth Based on Activities Performed

TABLE 1. Minimum Number of Grid Openings Required To Be Counted to Achieve a Given Analytical Sensitivity and Detection Limit. (Adapted from ISO 10312)

Analytical Sensitivity Structures/cc	Limit of Detection Structures/cc	Volume of Air Sampled (Liters)					
		500	1000	2000	3000	4000	5000
0.0001	0.0003	1066	533	267	178	134	107
0.0002	0.0006	533	267	134	89	67	54
0.0003	0.0009	358	178	89	60	45	36
0.0004	0.0012	267	134	67	45	34	27
0.0005	0.0015	214	107	54	36	27	22
0.0007	0.0021	153	77	39	26	20	16
0.001	0.003	107	54	27	18	14	11
0.002	0.006	54	27	14	9	7	6
0.003	0.009	36	18	9	6	5	4
0.004	0.012	27	14	7	5	4	4
0.005	0.015	22	11	6	4	4	4
0.007	0.021	16	8	4	4	4	4
0.01	0.030	11	6	4	4	4	4

TABLE 2. Suggested Meteorological Station Specifications

Variable	Accuracy	Resolution
Wind Speed (horizontal and vertical)	± (0.2 m/s + 5% of observed)	0.1 m/s
Wind Direction (azimuth and elevation)	± 5 degrees	1.0 degrees
Ambient Temperature	± 0.5° C	0.1° C
Precipitation	± 10% of observed or ± 0.5 mm	0.3 mm
Pressure	± 3 mb (0.3 kPa)	0.5 mb
Solar Radiation	± 5% of observed	10 W/m^2

m/s = meters per second
°C = degrees Centigrade
mm = millimeters
mb = millibar
W/m^2 = watts per square meter
kPa = kilopascal

TABLE 3. Soil Sampling Depth Based on Activities Performed

Activity Based Sampling Scenario	Soil Sampling Depth
Raking (metal garden rake)	Surface to 3 inches
Raking (leaf rake)	Surface to 2 inch
ATV riding	Surface to 2 inch
Rototilling	Surface to 12 inches
Digging	Surface to depth of excavation
Child Playing in the dirt	Surface to 3 inches
Weed Whacking	Surface to 2 inches
Lawn Mowing	Surface to 2 inch
Walking with Stroller	Surface to 2 inch
Two Bicycles	Surface to 2 inch
Activities on solid surfaces such as asphalt or concrete	Microvacuum ASTM D 5755